

MRI vs. CT in acute neck infections

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No disclosures

Choosing the most appropriate imaging



- 1) Feasibility in the emergency department
- 2) Confirm diagnosis and rule out differential
- 3) Demonstrate surgically drainable abscesses
- 4) Extract clinically relevant and prognostically significant information
- 5) Rule out complications

Choosing the most appropriate imaging



Focus on neck soft tissue infections

Pharyngotonsillar

Odontogenic

Suppurative lymphadenitis

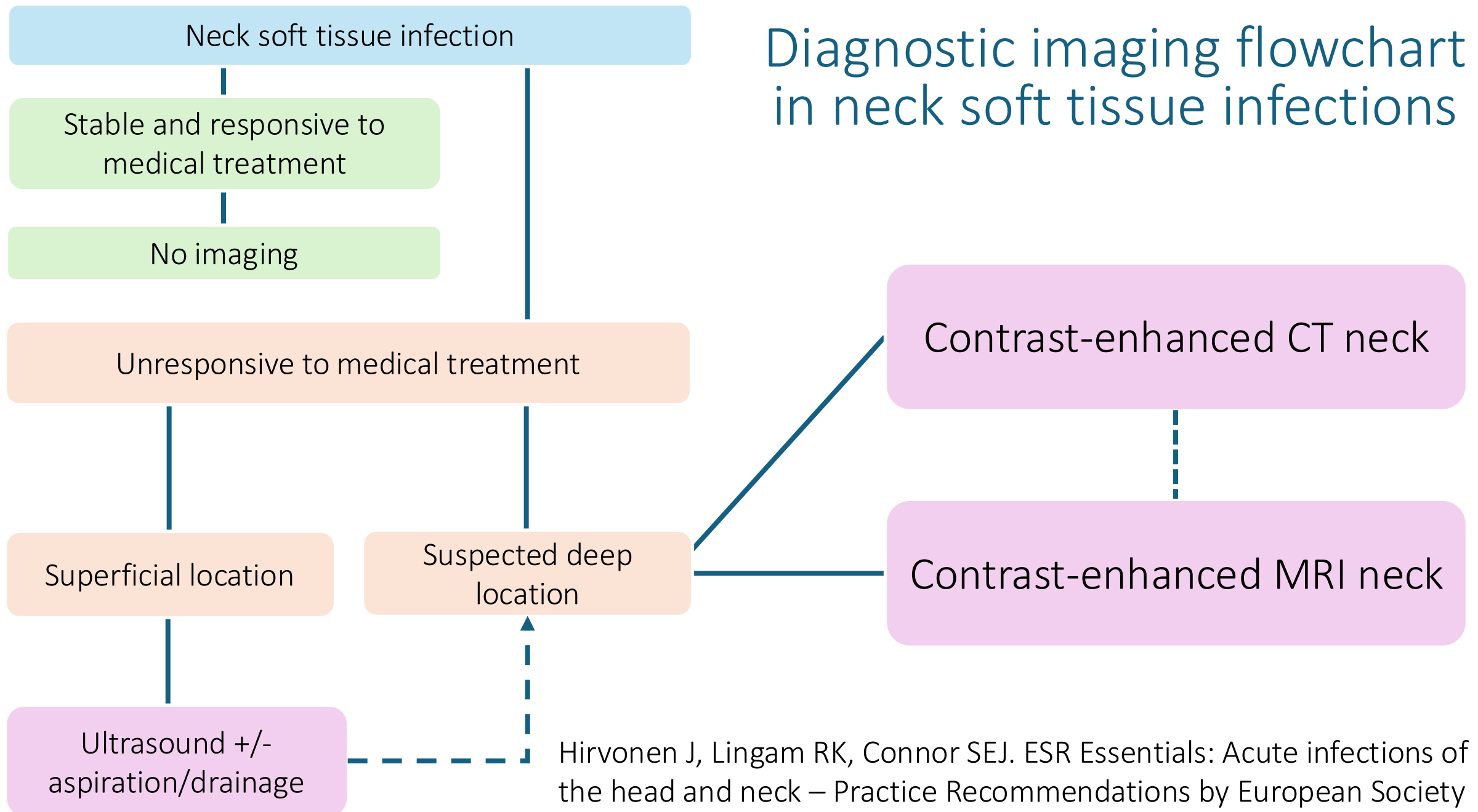
Not included

Subacute skull base infections

Complicated sinonasal and temporal bone infections

Intracranial/spinal spread of infections

Diagnostic imaging flowchart in neck soft tissue infections



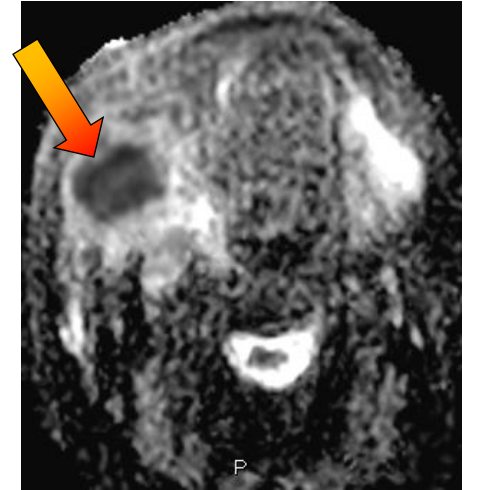
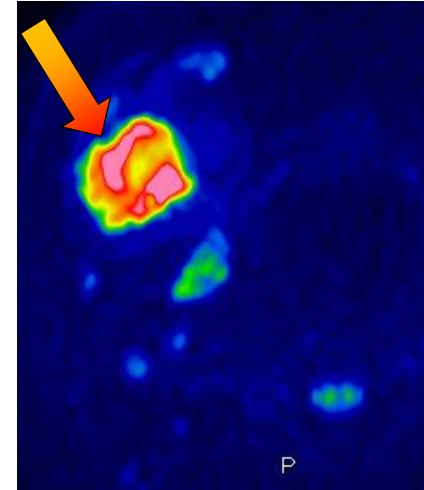
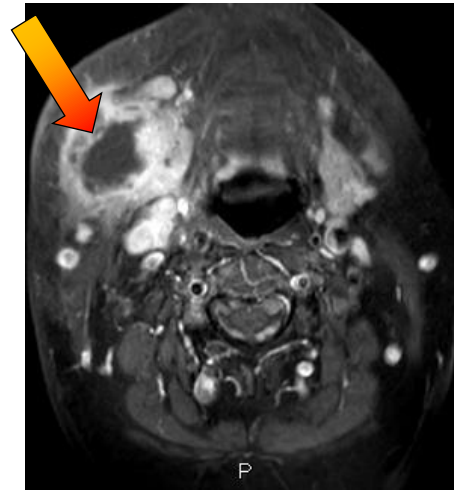
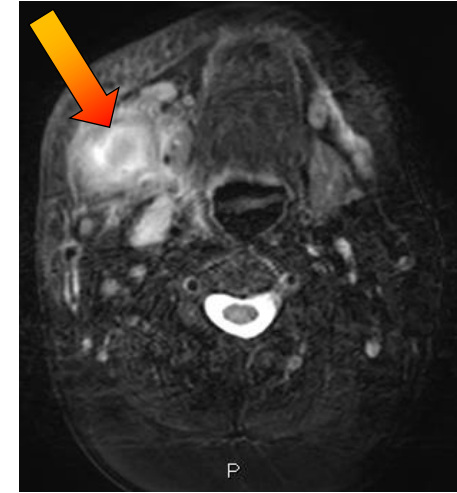
Hirvonen J, Lingam RK, Connor SEJ. ESR Essentials: Acute infections of the head and neck – Practice Recommendations by European Society of Head and Neck Radiology. *Eur Radiol* 2026;36(1):334-343.

CT is monoparametric



Mass effect, surrounding edema,
low-density core, enhancing rim

MRI is multiparametric

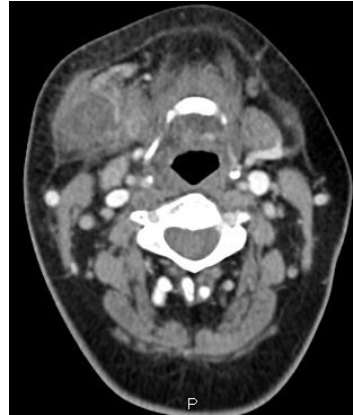


High T2SI collection, non-enhancing,
restricted diffusion (low ADC)

Advantages of CT and MRI

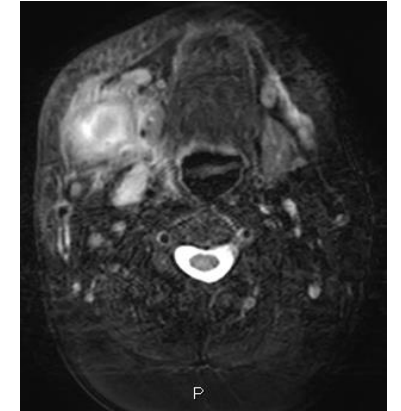
CT

- Speed
- Availability
- Lower cost
- Large coverage (mediastinum)
- Easier vessel assessment
- Gas detection
- Bone destruction
- Spectral CT has improved performance



MRI

- Soft tissue contrast
- No ionizing radiation
- DWI shows pus directly
- Bone marrow edema before bony destruction
- Edema patterns have prognostic significance

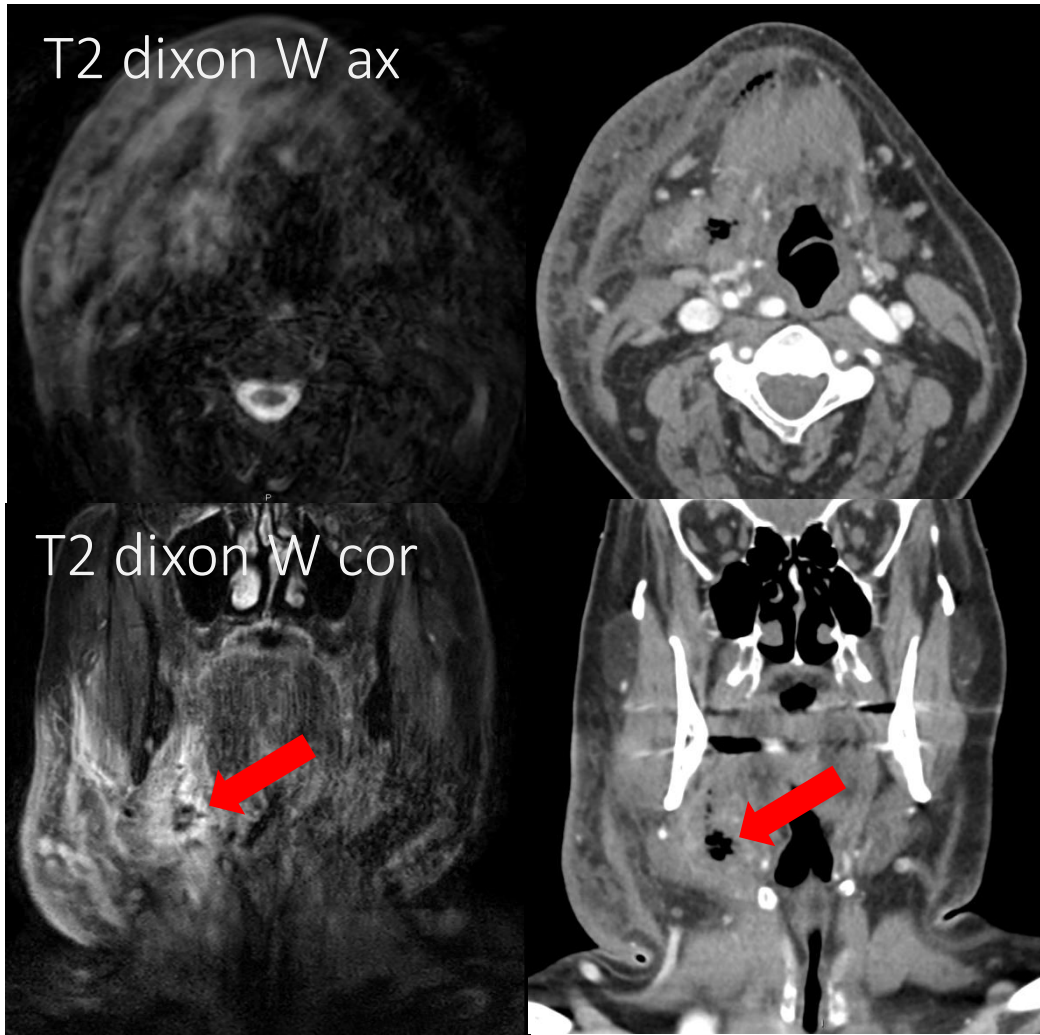




Feasibility

MRI is feasible in emergency patients

465 studies in 2013–2019: MRI is suitable for *almost* everyone



25/465 MRI failures

- 13 requests not fulfilled
 - Unknown (4), claustrophobia (3), MRI too busy (3), high fever (2), patient too large (1)
- 12 scans did not complete
 - Restlessness (5), dyspnea (3), back pain (1), noise (1), tremor (1)
- 22 (88%) required CT

95% success rate

How do we scan?

Table 1 MRI protocol for acute neck infections

Sequence	Gd contrast	Orientation	Purpose
T2 Dixon	No	Axial, coronal	Normal anatomy (in-phase), tissue edema (water image)
T1 SE	No	Axial	Normal anatomy, especially fat pads
DWI	No	Axial	Detection of hypercellularity in solid tissue (normal lymph nodes, tumors), and purulence (abscess formation) in fluid collections
T1 Dixon	Yes	Axial, coronal, sagittal	Demonstration of abnormal tissue enhancement (cellulitis, phlegmon), and indirect demonstration of non-enhancement in fluid collections and necrosis

Hirvonen et al. *Insights into Imaging* (2023) 14:5
<https://doi.org/10.1186/s13244-022-01347-9>

Insights into Imaging
ESIR EUROPEAN SOCIETY
OF RADIOLOGY

EDUCATIONAL REVIEW

Open Access

MRI of acute neck infections: evidence summary and pictorial review

Jussi Hirvonen^{1,2*} , Jaakko Heikkinen¹, Mikko Nyman¹, Tatu Happonen¹, Jarno Velhonoja³, Heikki Irjala³, Tero Soukka⁴, Kimmo Mattila¹ and Janne Nurminen¹



Scan time ~25 min

Diagnostic accuracy for
surgically drainable
abscesses

Diagnostic accuracy of CT : Systematic review & Meta-analysis

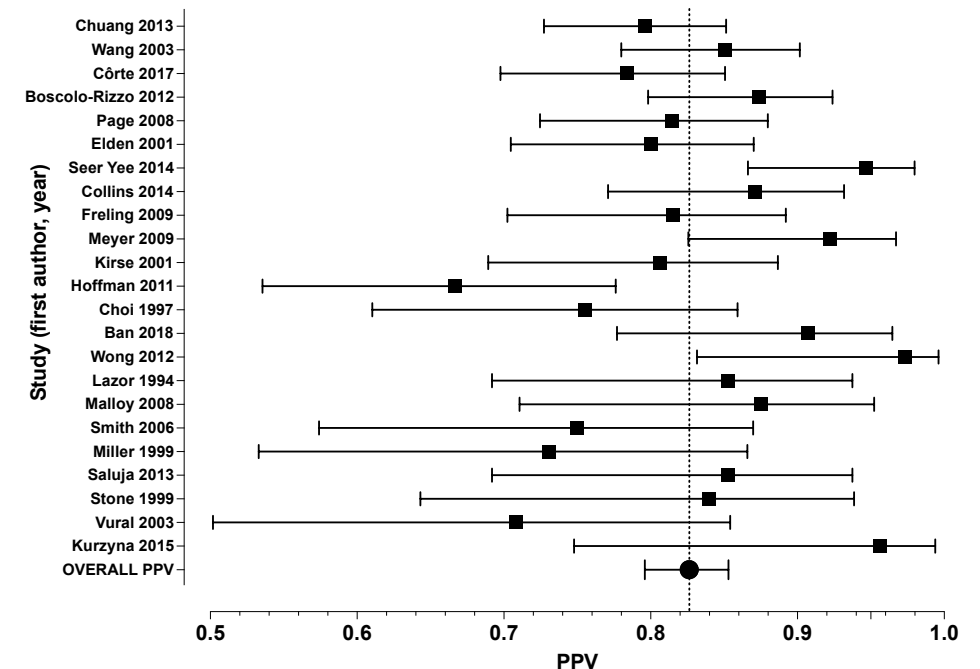
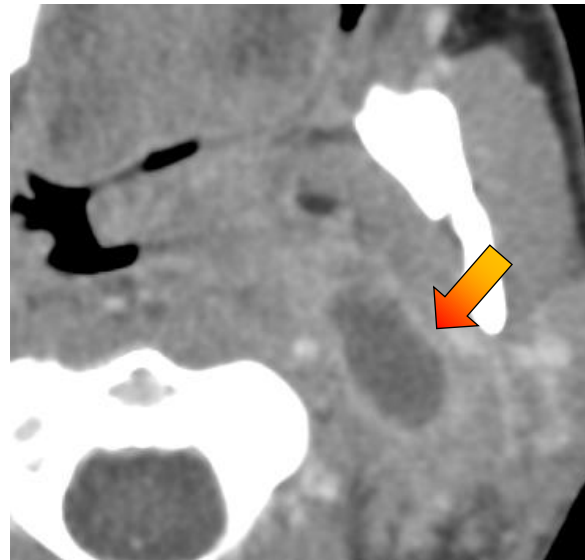
Sensitivity 0.72–0.95
Specificity 0.18–0.67

Overall PPV 0.83
(95%CI 0.80–0.85)

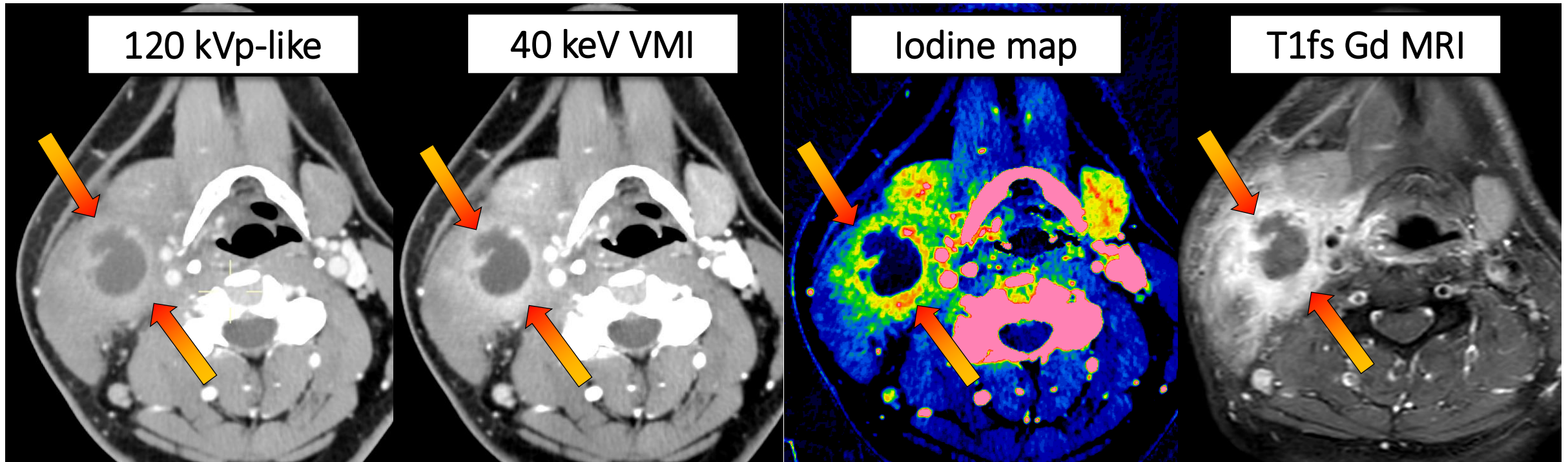
23 studies
1453 patients
1208 true positives
245 false positives

CT abscess criteria:

- Mass
- Hypodensity
- Surrounding edema
- Rim enhancement
- Bulging
- Presence of air



Spectral CT can improve the diagnostic power of CT



MRI has excellent accuracy in neck abscesses



Sensitivity 0.99

Specificity 0.89

PPV 0.95

NPV 0.98

Accuracy 0.96

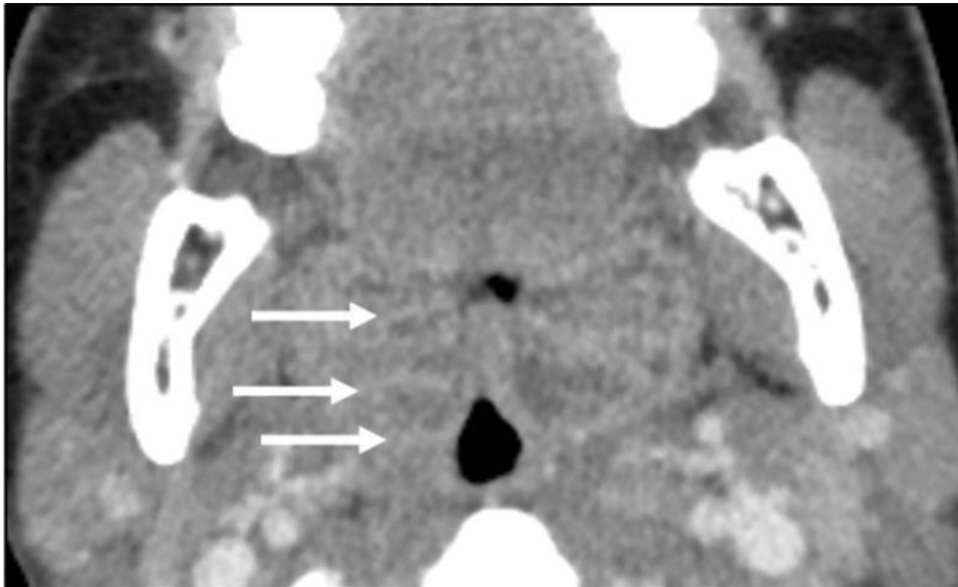
Surgical proof of purulence
(N = 274 patients)

Tonsillitis with no abscess

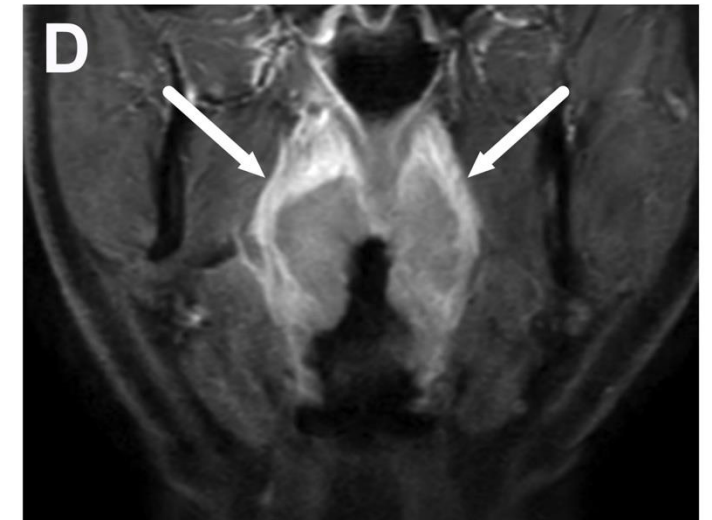
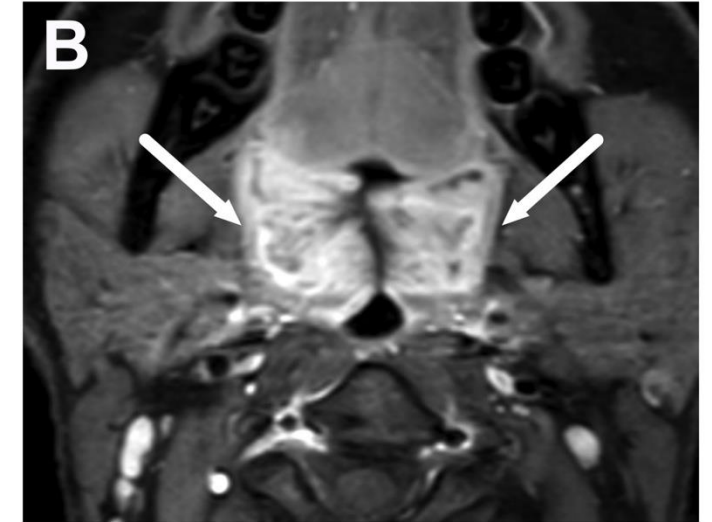
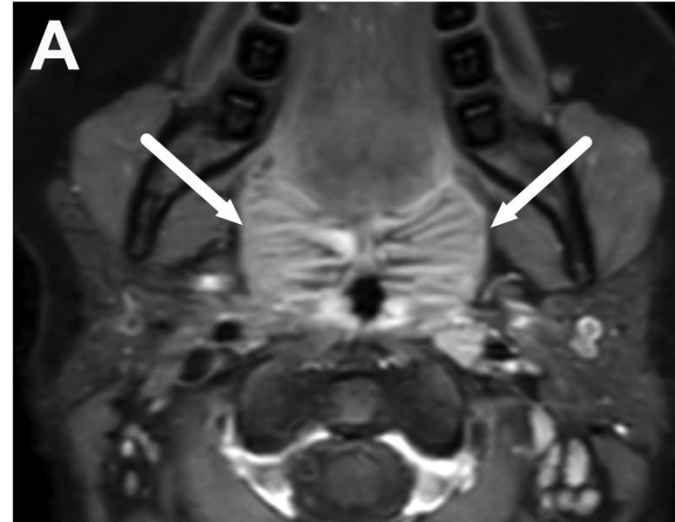
"Tonsillitis"

"Peritonsillitis"

Look for tiger-stripe appearance
(fluid within tonsillar crypts)



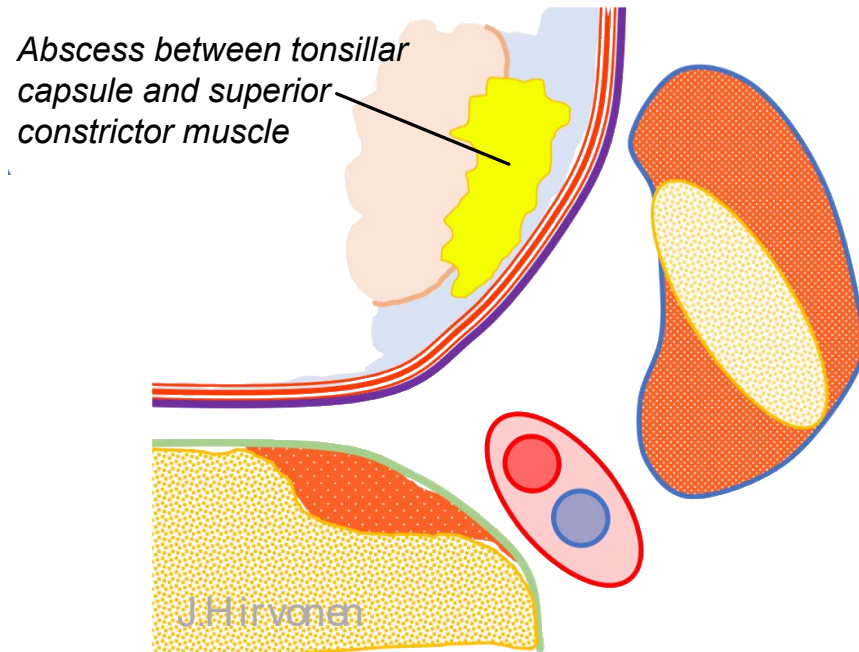
Bhatt *Emerg Rad* 2018



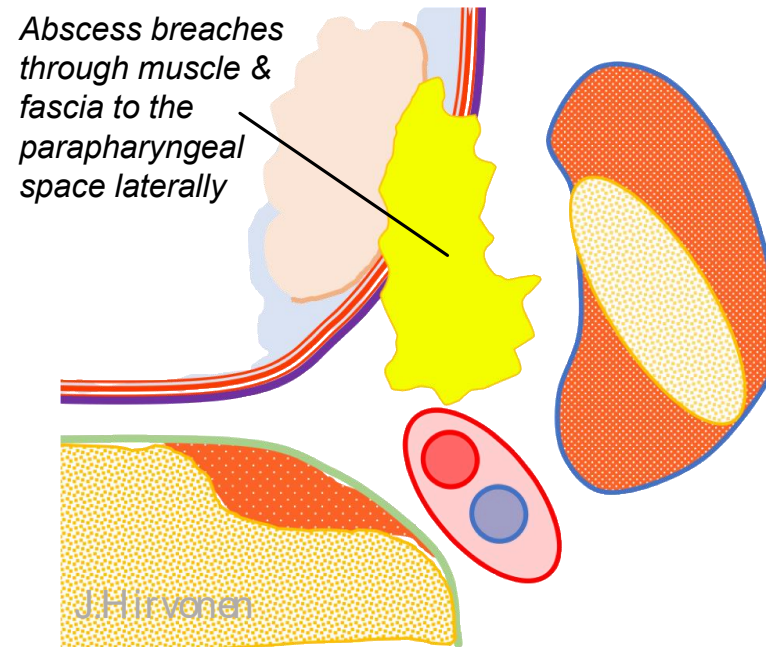
Hirvonen *Insights Imaging* 2023

Classification of tonsillar infections

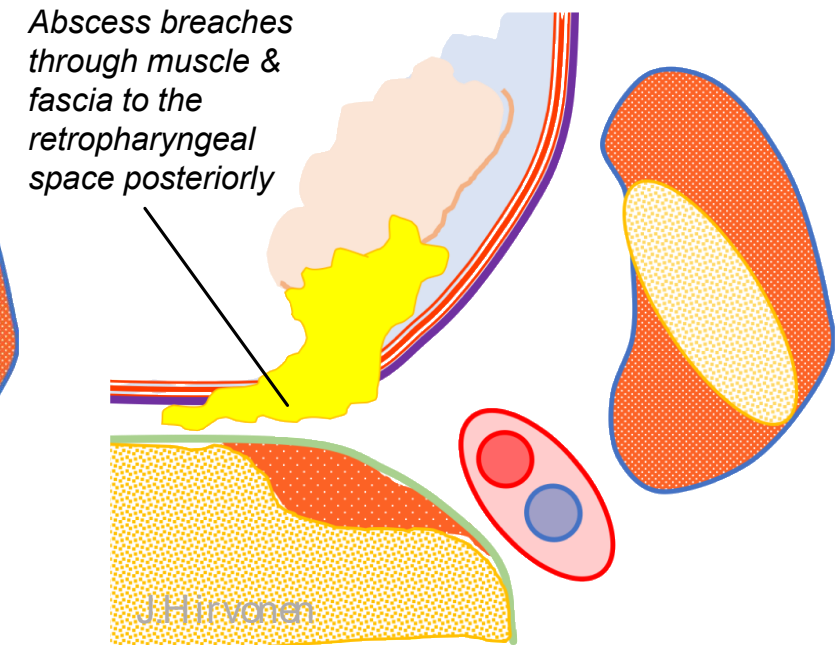
Peritonsillar abscess (PTA)



Parapharyngeal abscess (PPA)



Retropharyngeal abscess (RPA)



AJNR

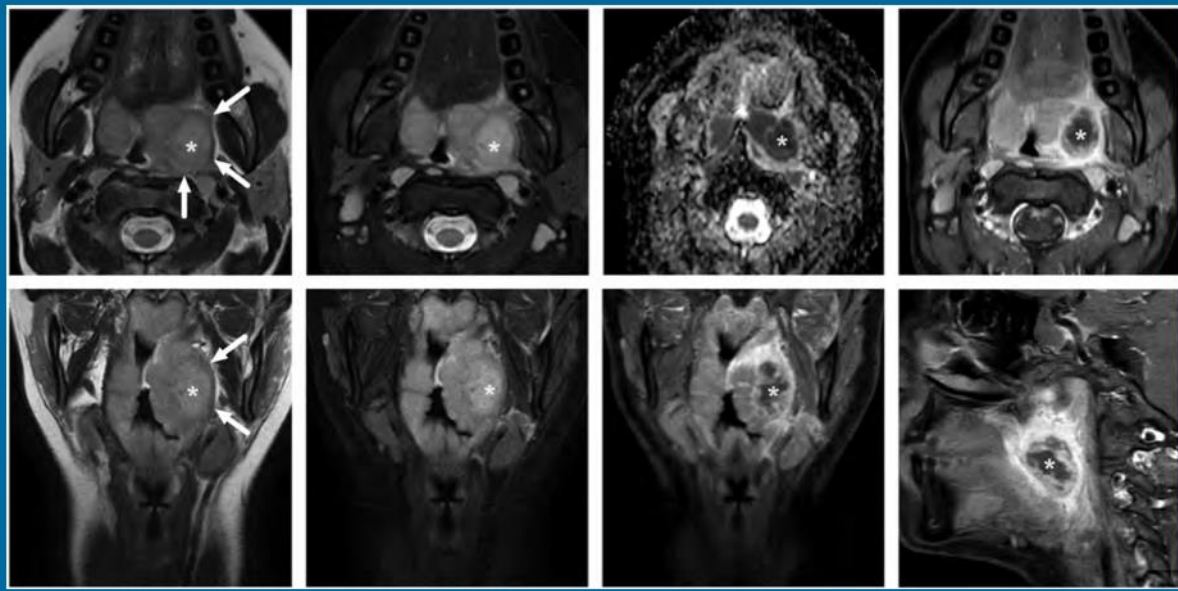
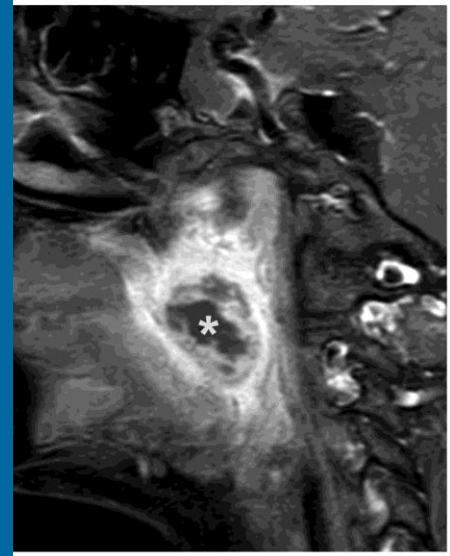
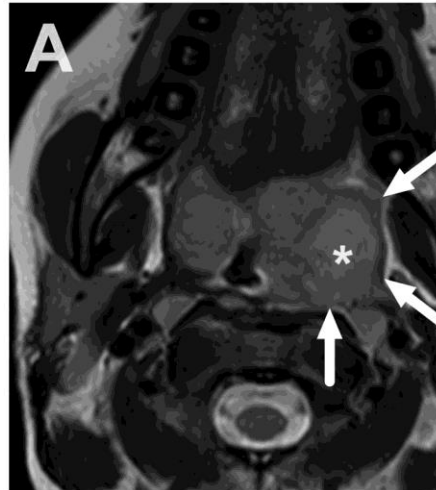
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INTERVENTIONAL NEURORADIOLOGY

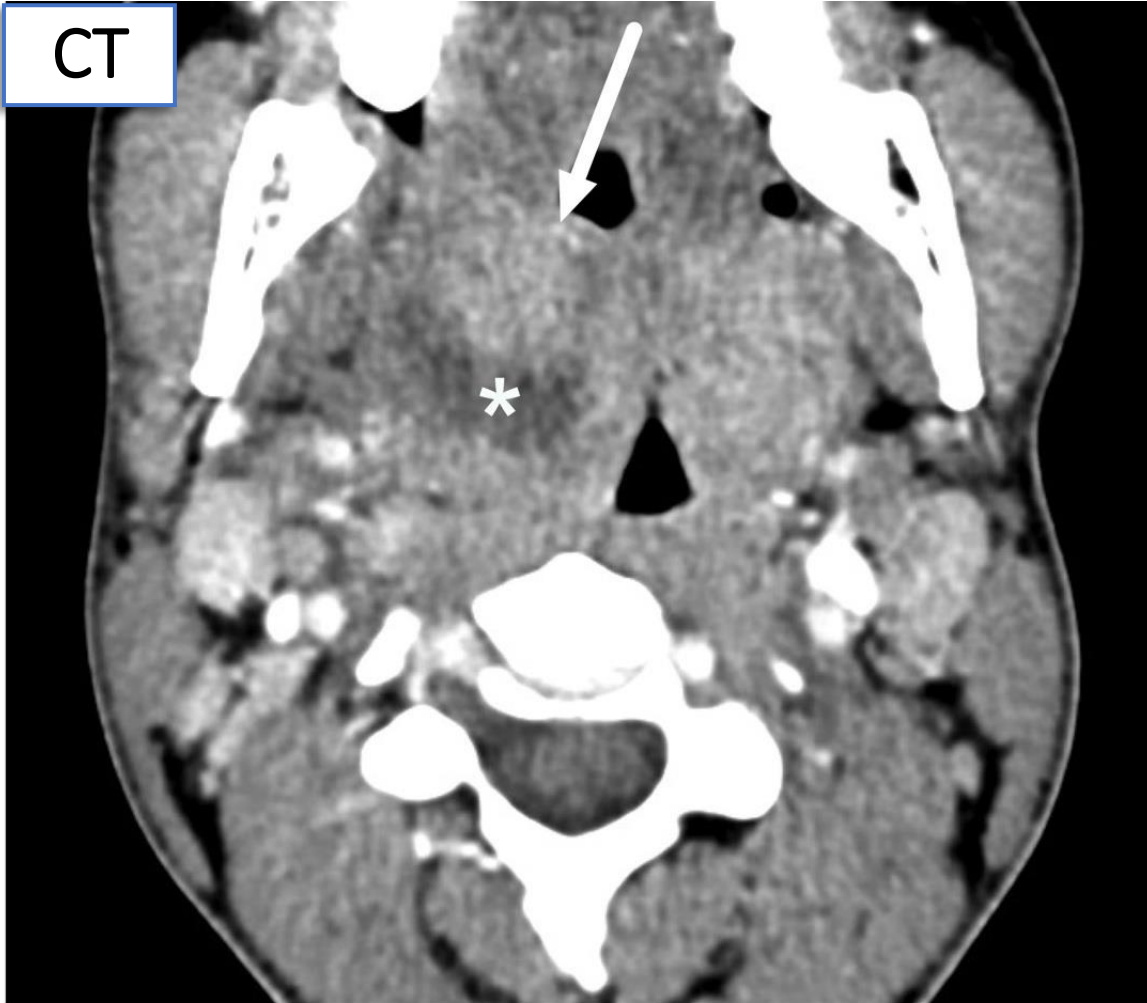
Sodium MRI at 7T for intracranial tumors
MRI of tonsillar infections
Arterial collapse during thrombectomy for stroke
Predictive value of imaging for NPH

Official Journal ASNR • ASFNR • ASHNR • ASPNR • ASSR

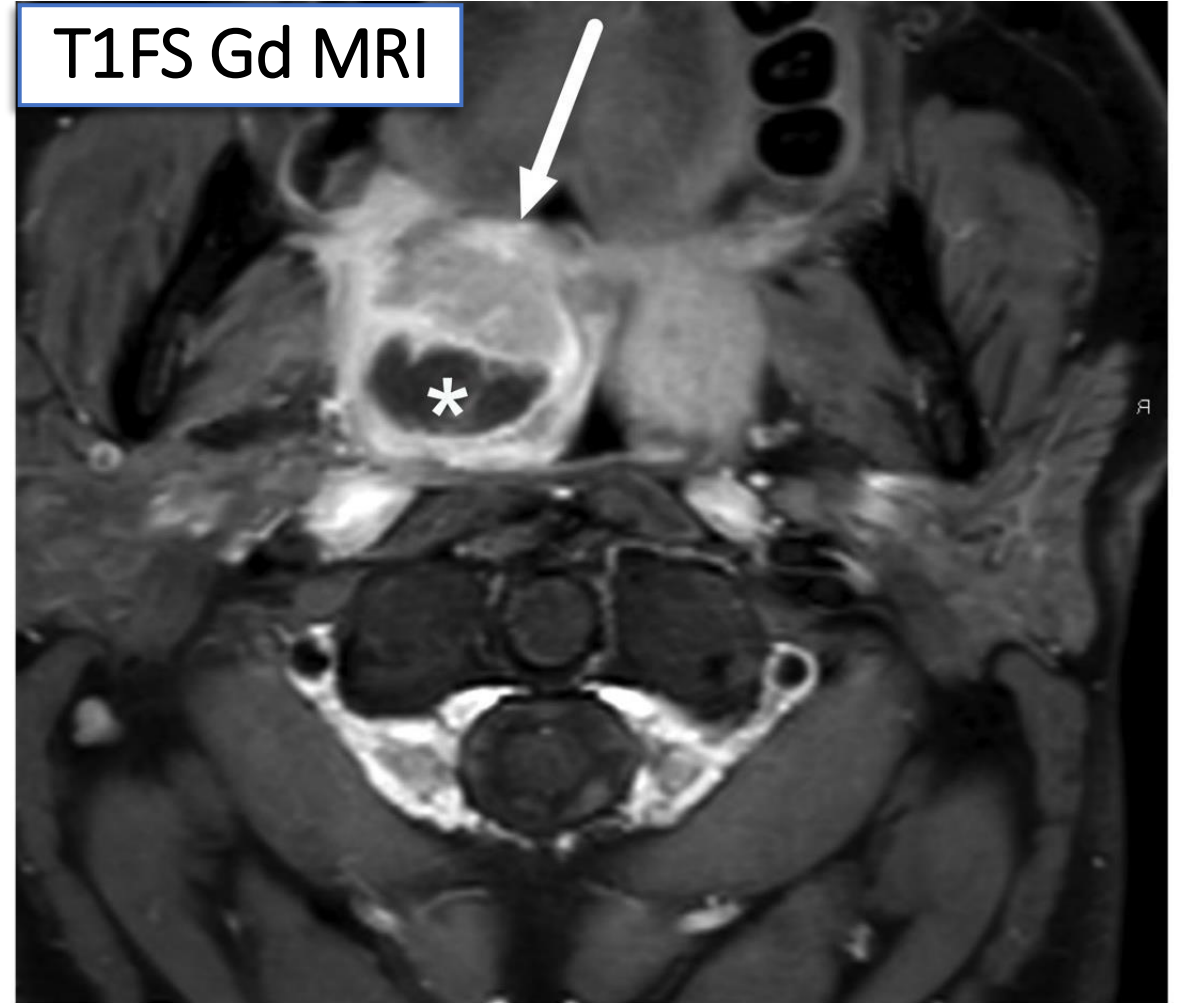


Peritonsillar abscess (PTA)

CT



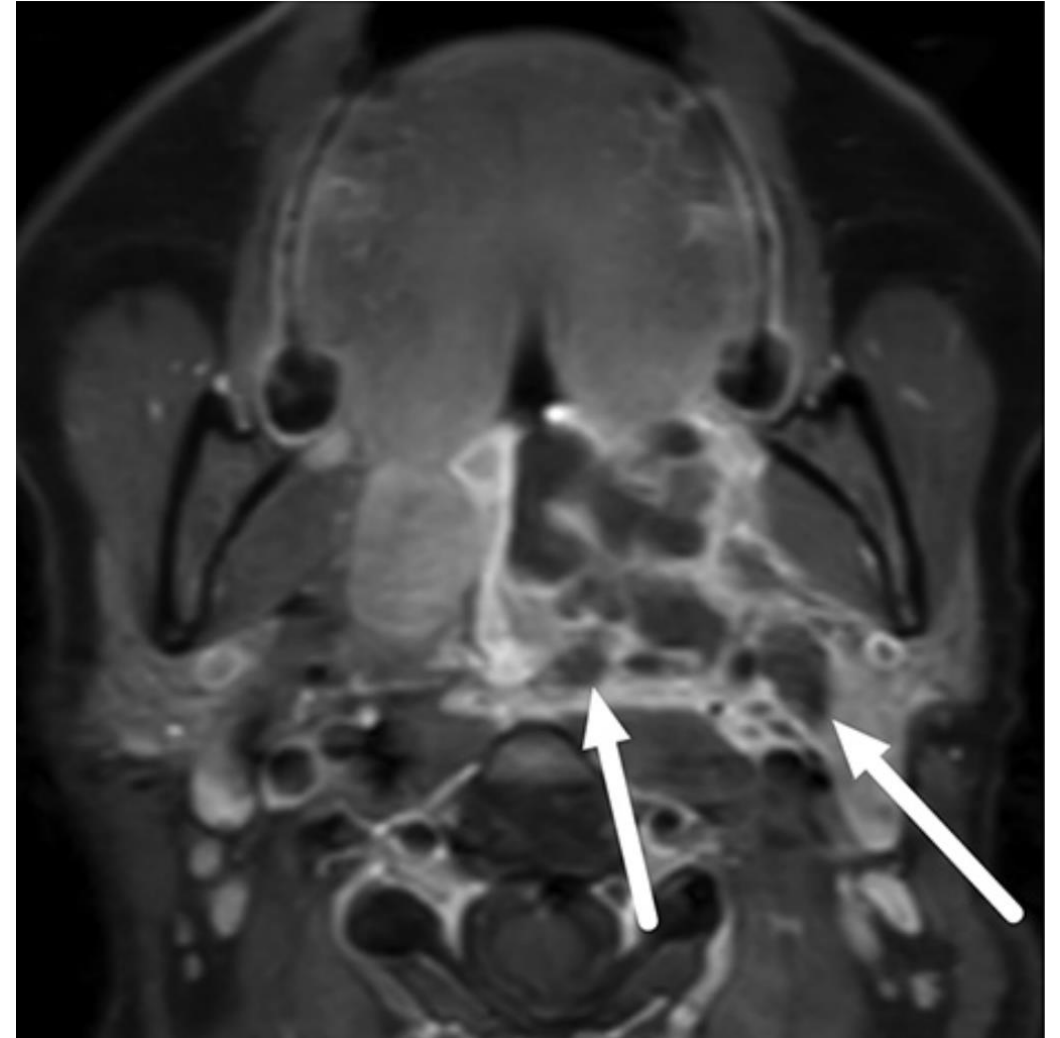
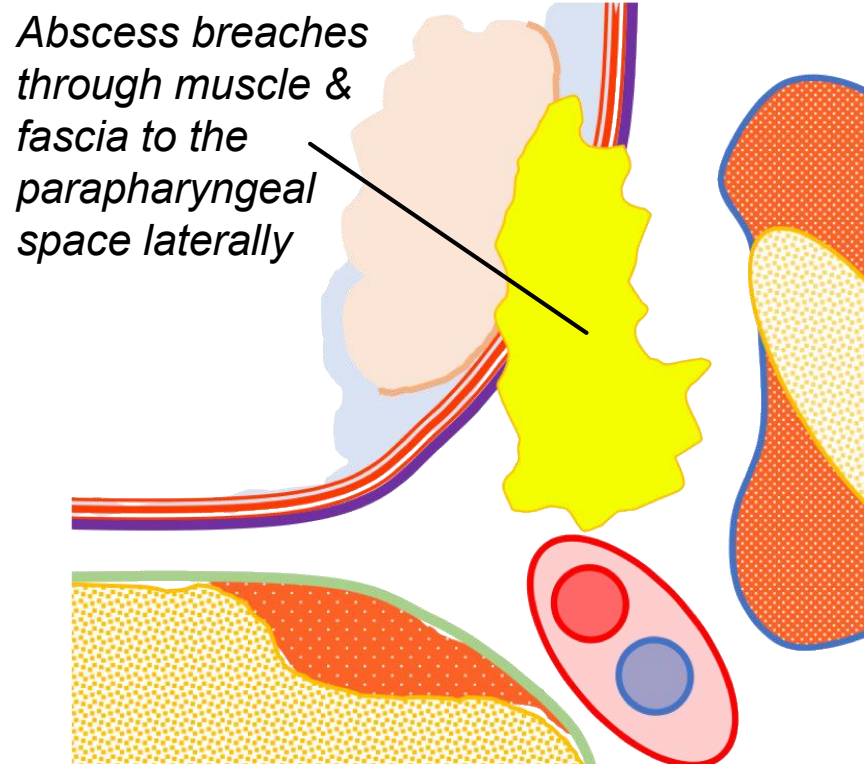
T1FS Gd MRI



Deep extension of PTA into PPS/RPS

Parapharyngeal abscess (PPA)

Sens 0.88
Spec 0.90
PPV 0.86
NPV 0.92
Acc 0.89

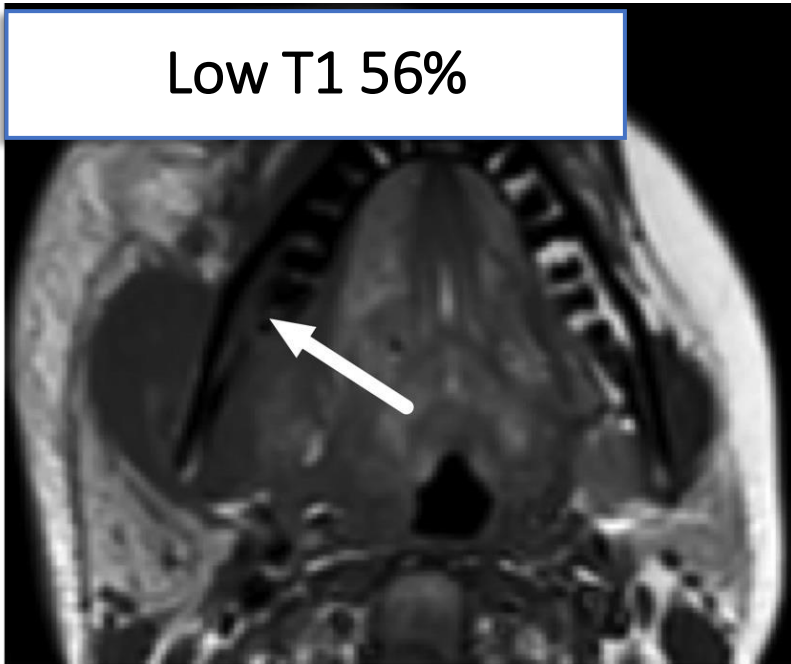


N=132

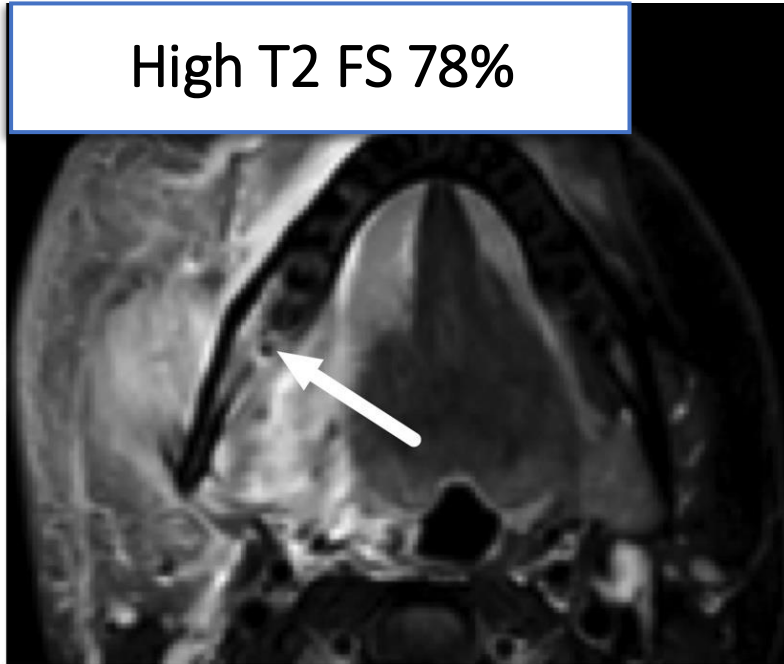
Odontogenic origins?

- Tooth decay
- Periapical changes
- Bone marrow changes
- Abscesses

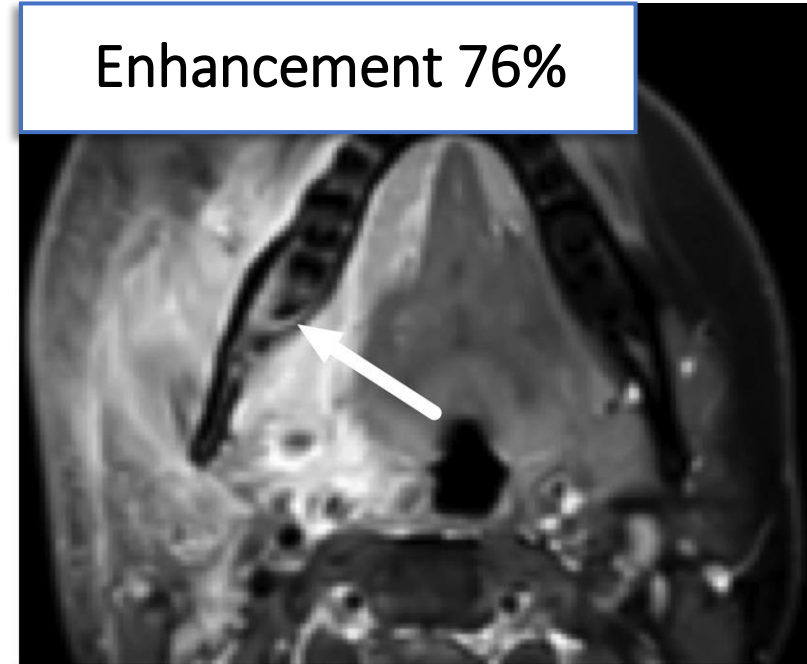
Low T1 56%



High T2 FS 78%

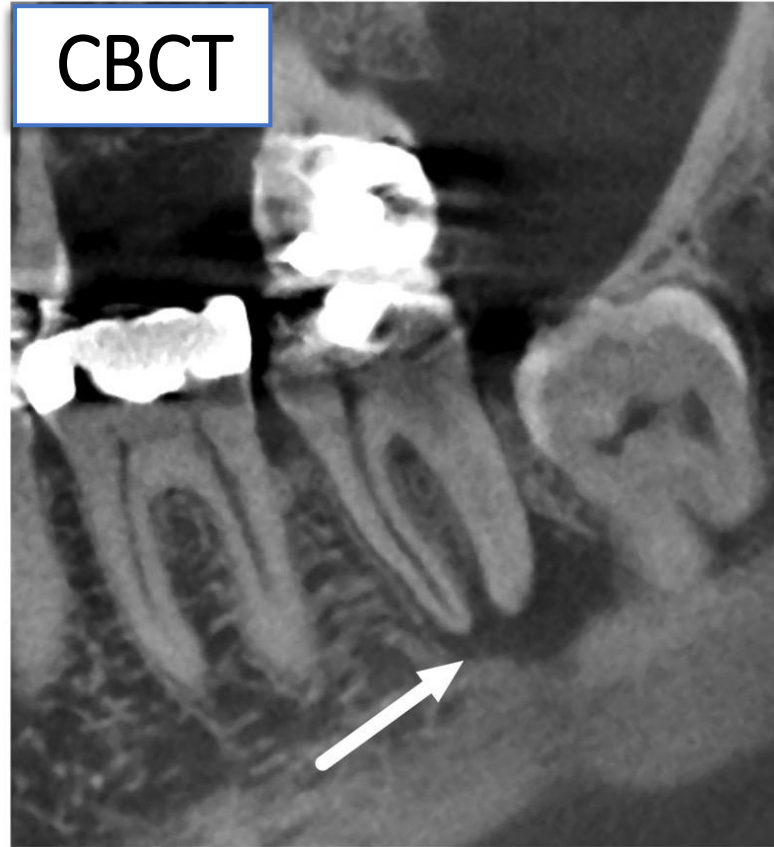
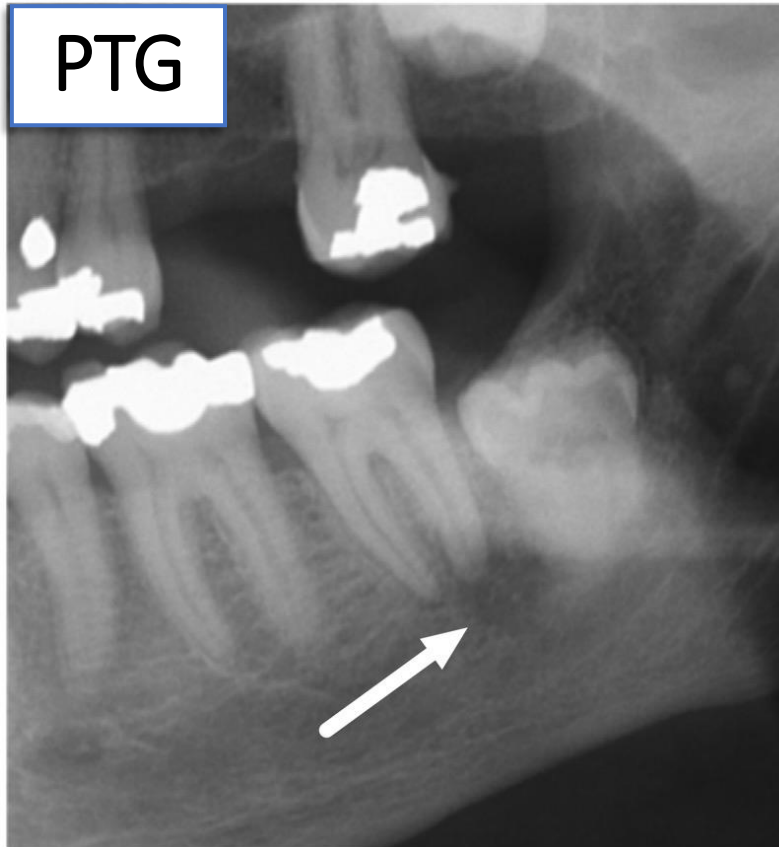


Enhancement 76%



Odontogenic origins?

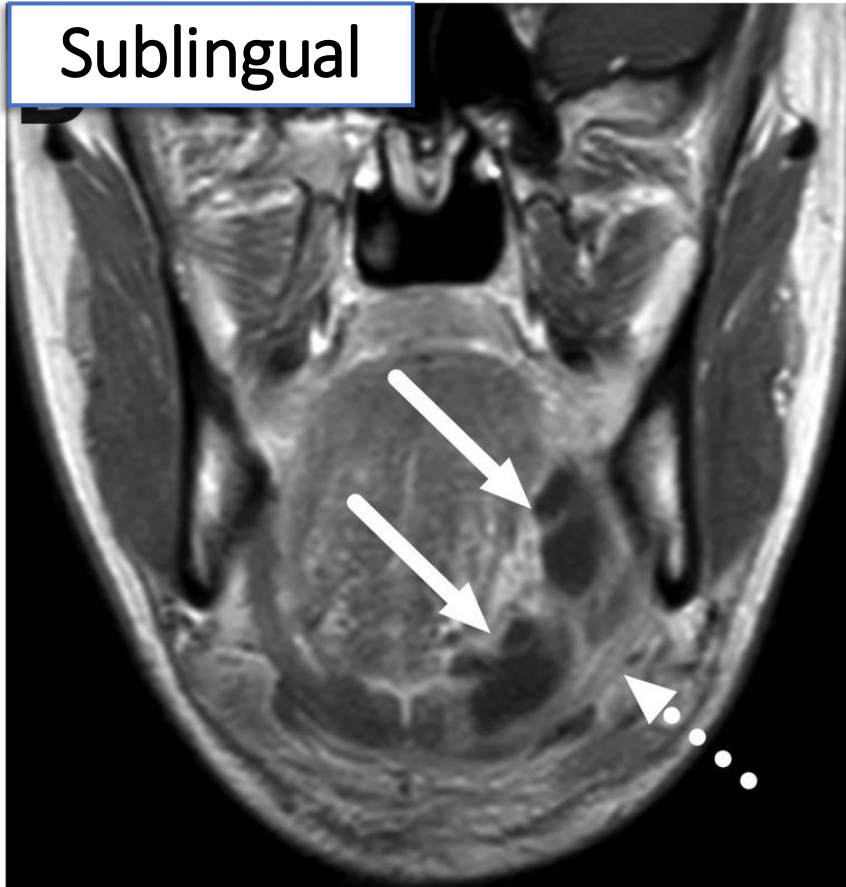
- Tooth decay
- **Periapical infection**
- Bone marrow edema
- Abscesses



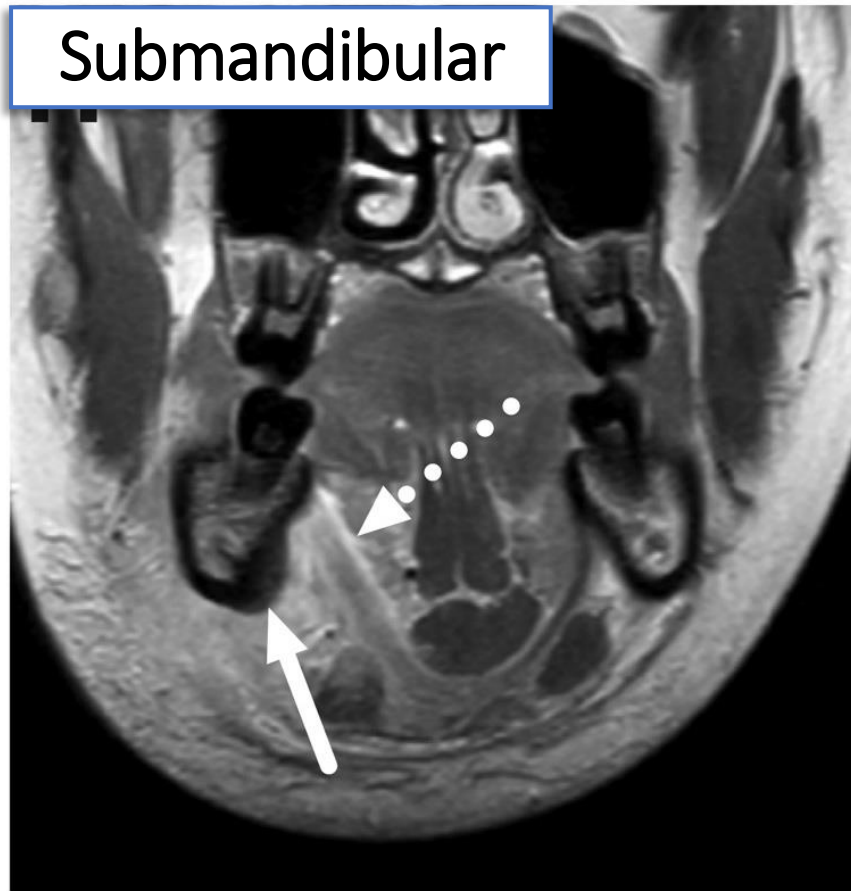
Oral cavity: mostly odontogenic abscesses

- Tooth decay
- Periapical changes
- Bone marrow changes
- Abscesses

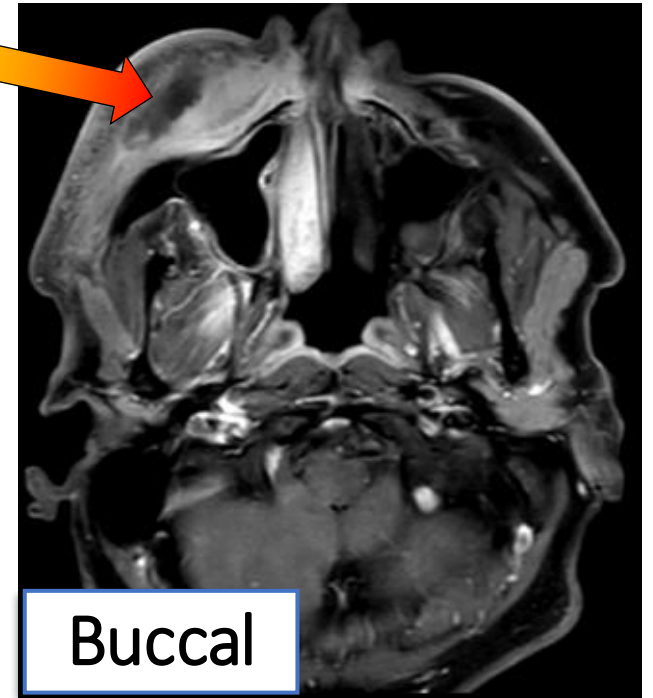
Sublingual



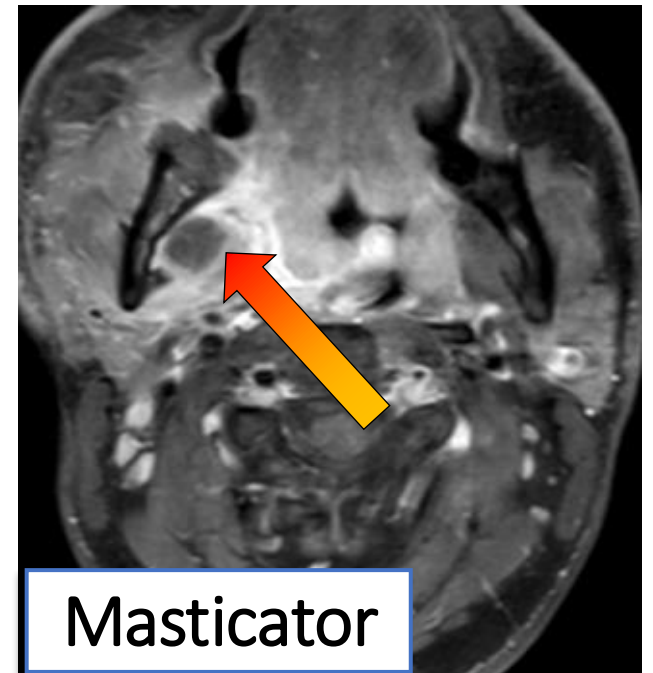
Submandibular



Buccal

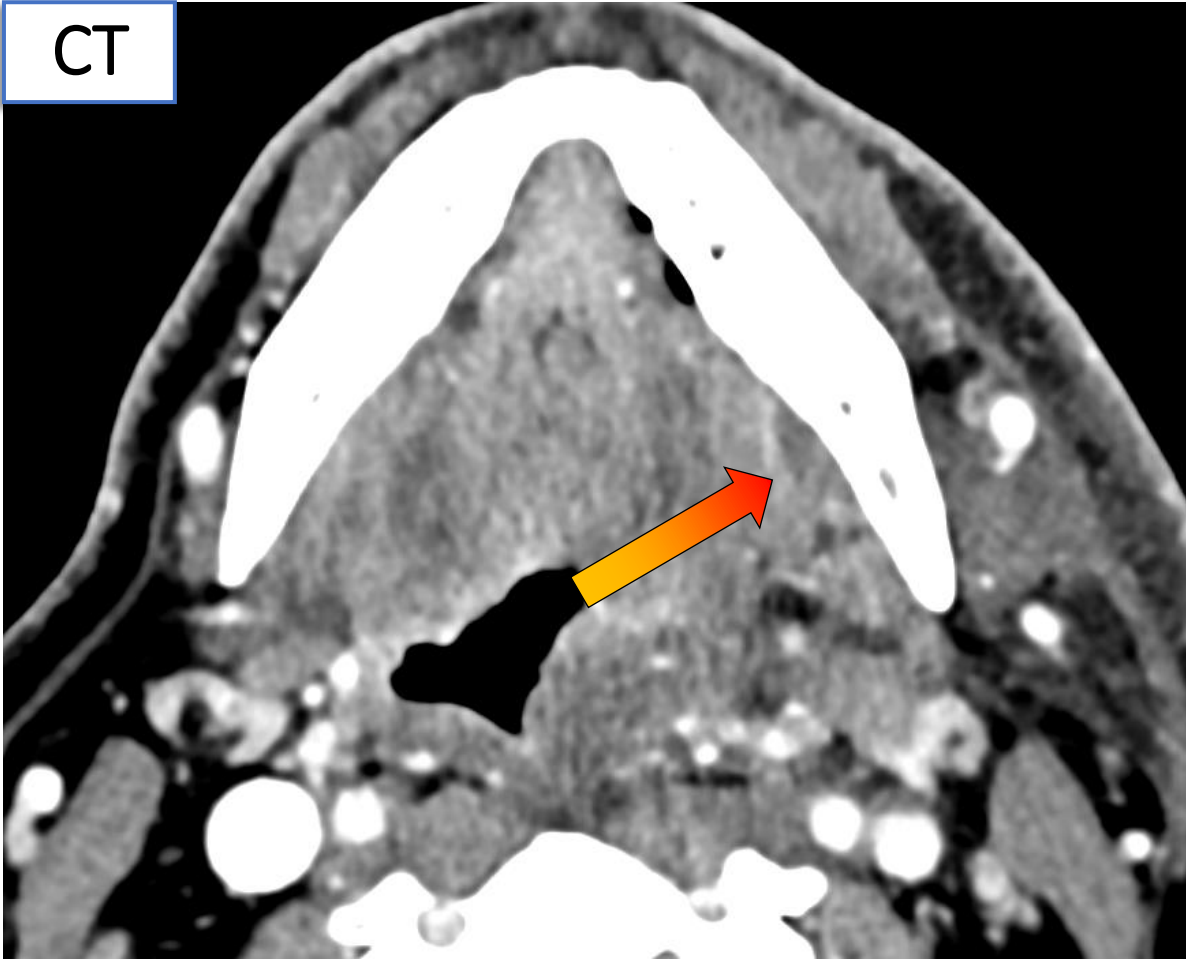


Masticator

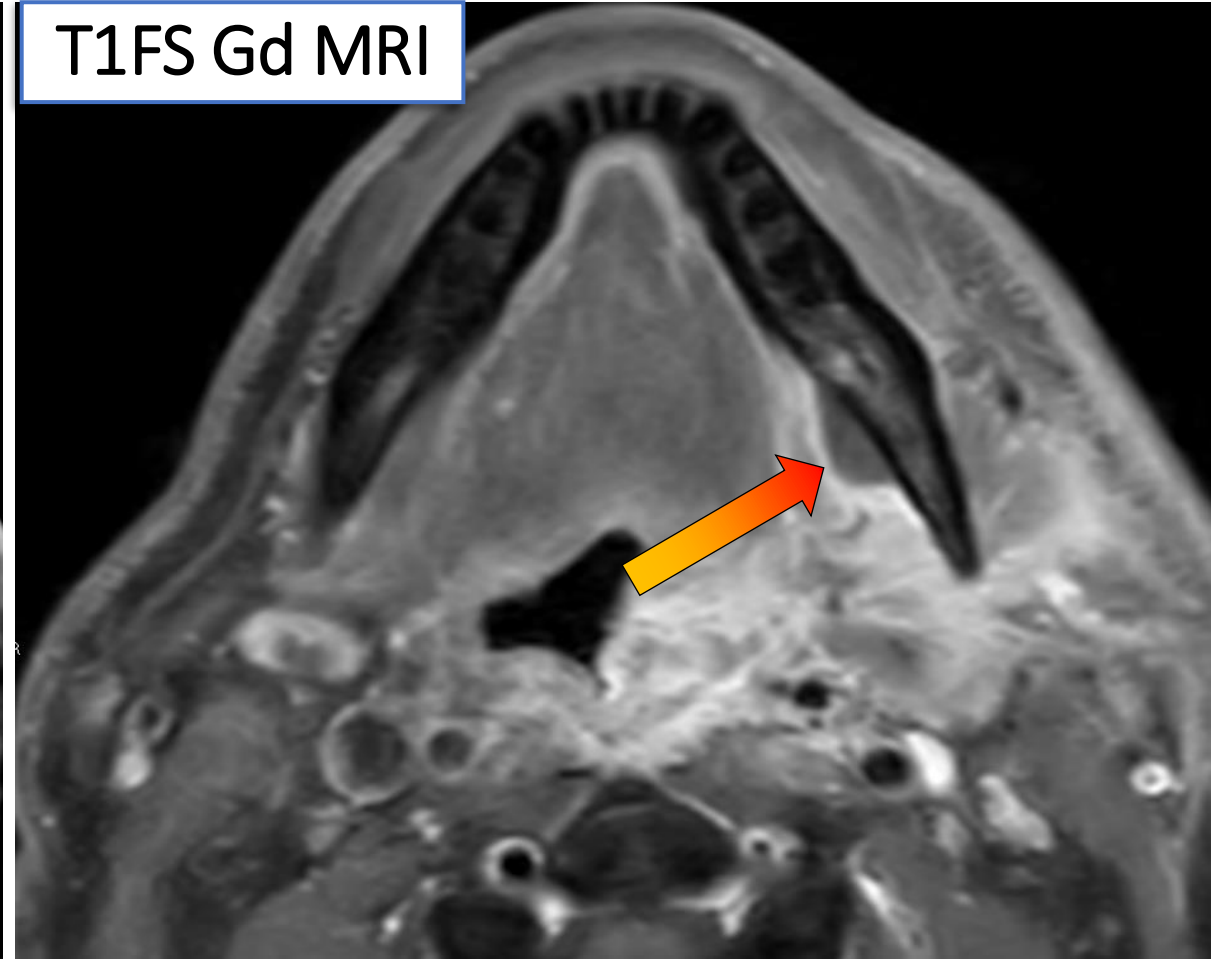


Subperiosteal odontogenic abscesses

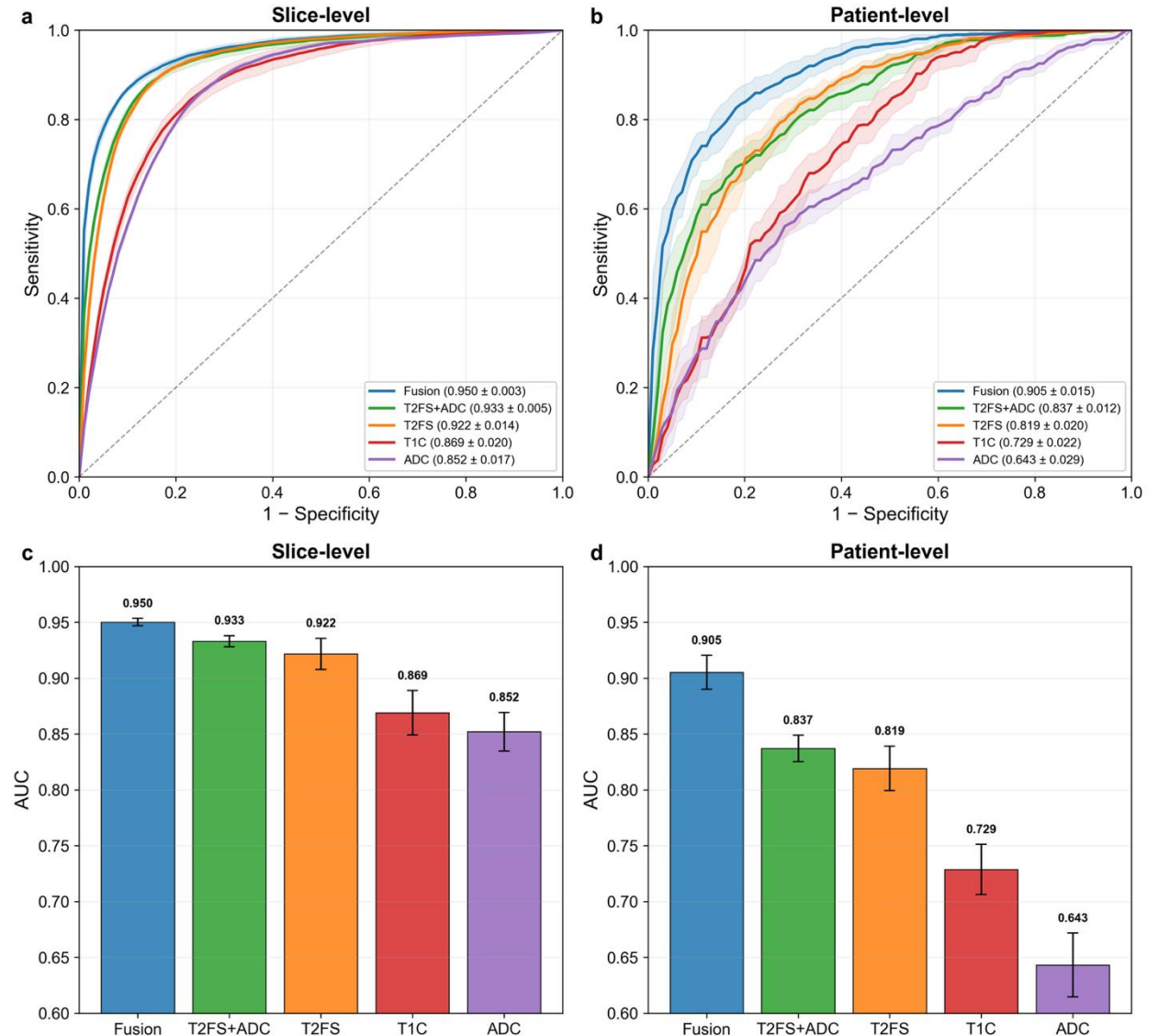
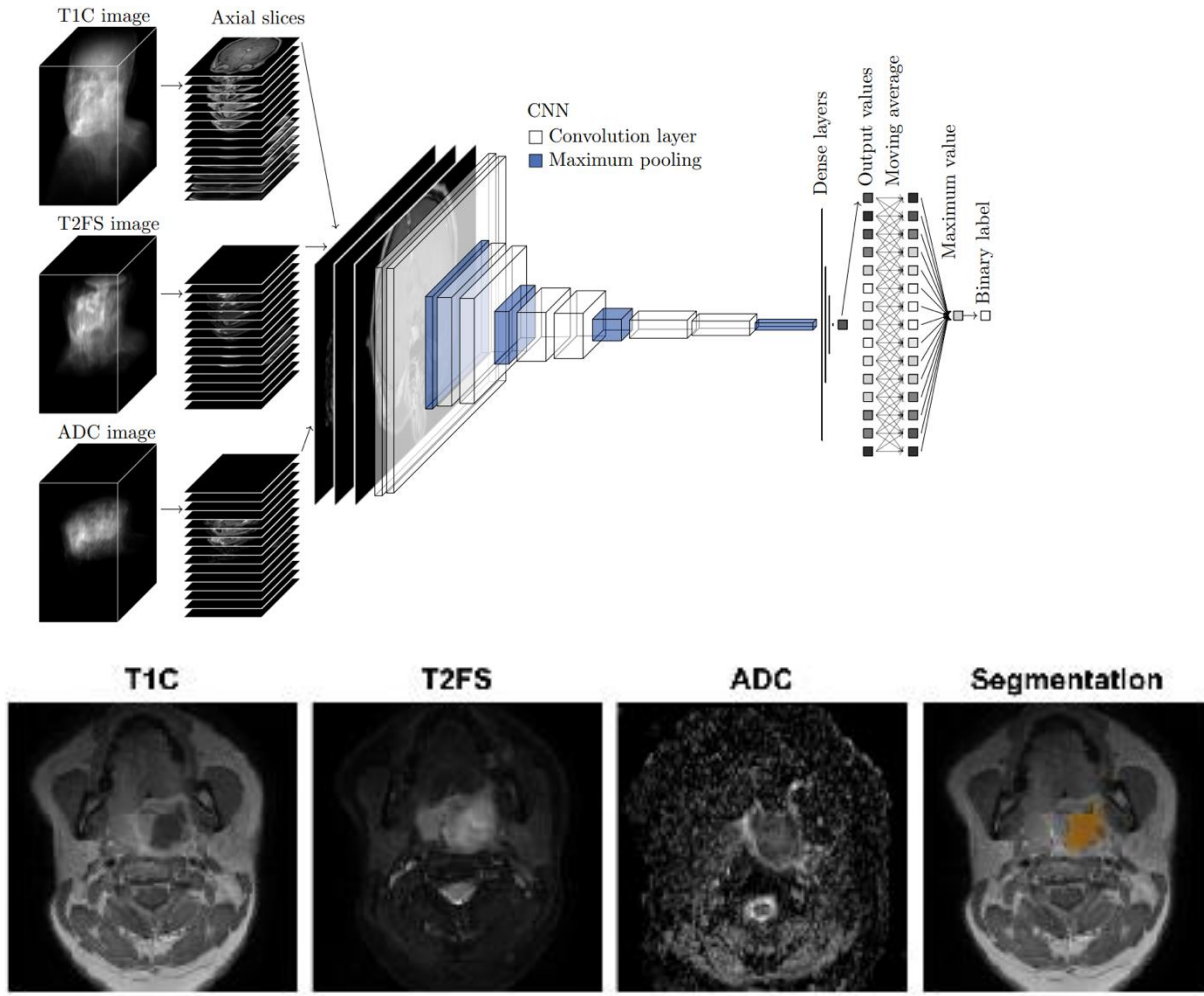
CT



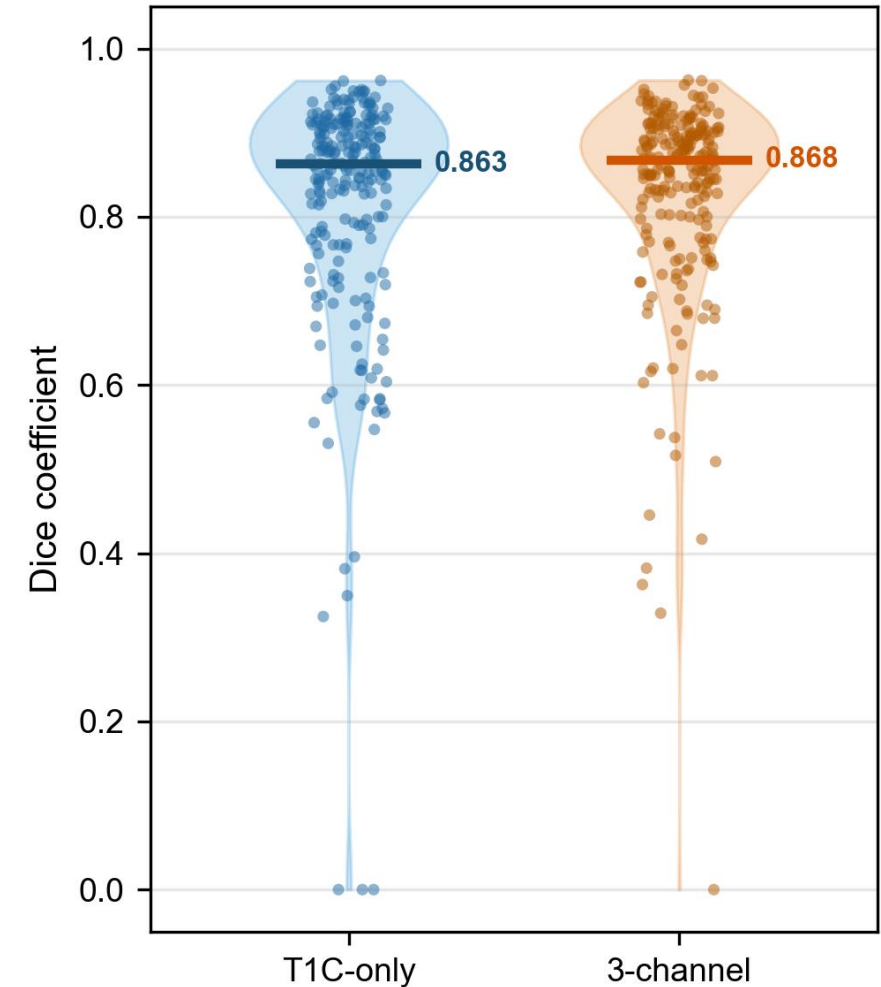
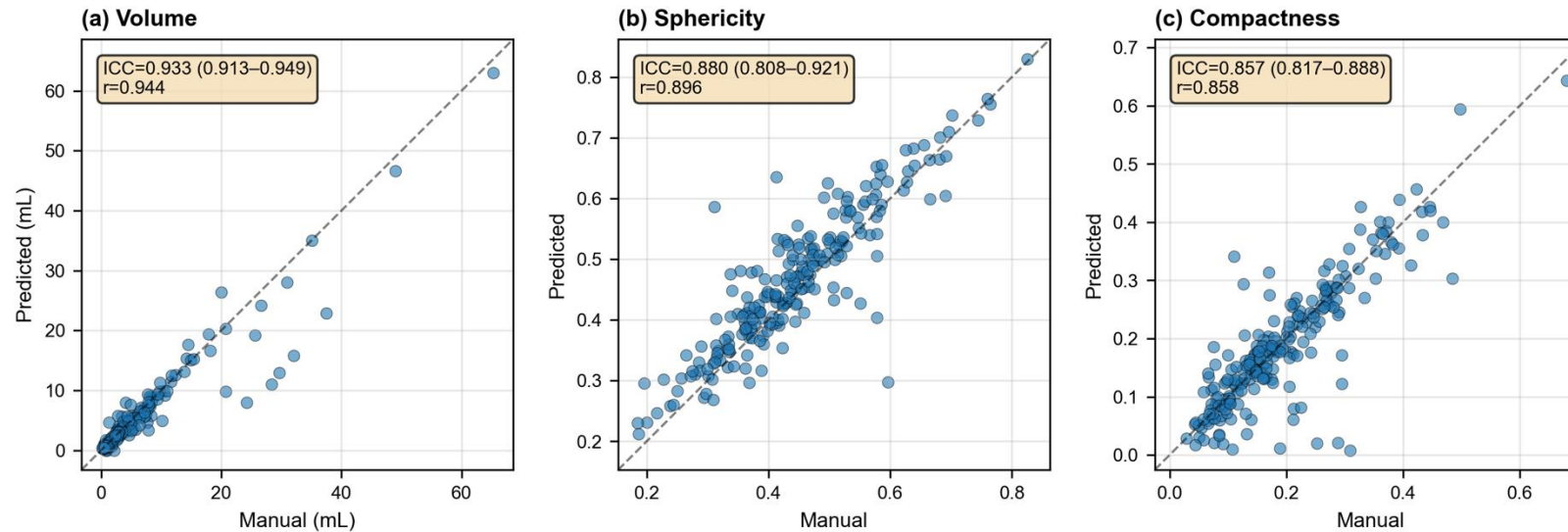
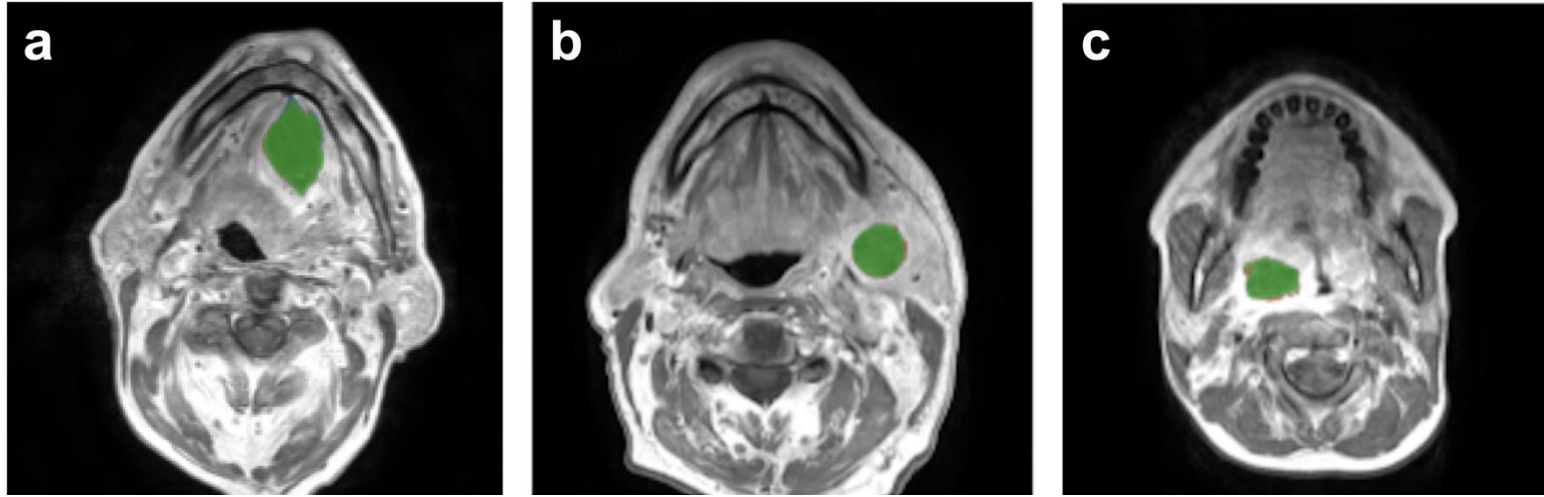
T1FS Gd MRI



Deep learning-based detection of neck abscesses



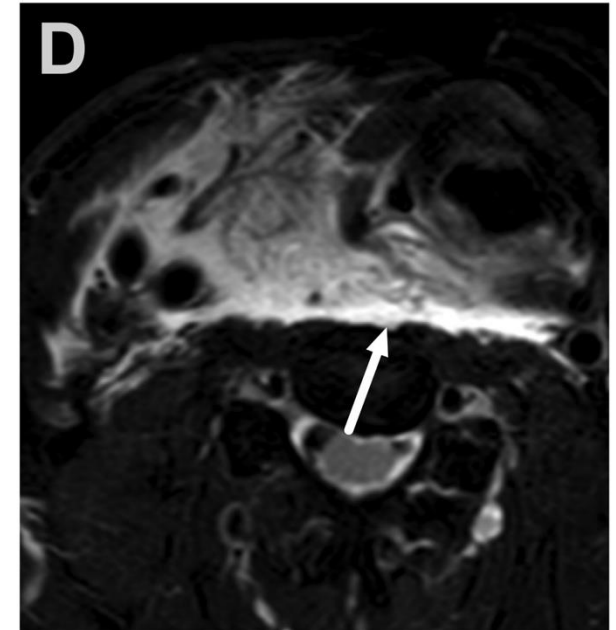
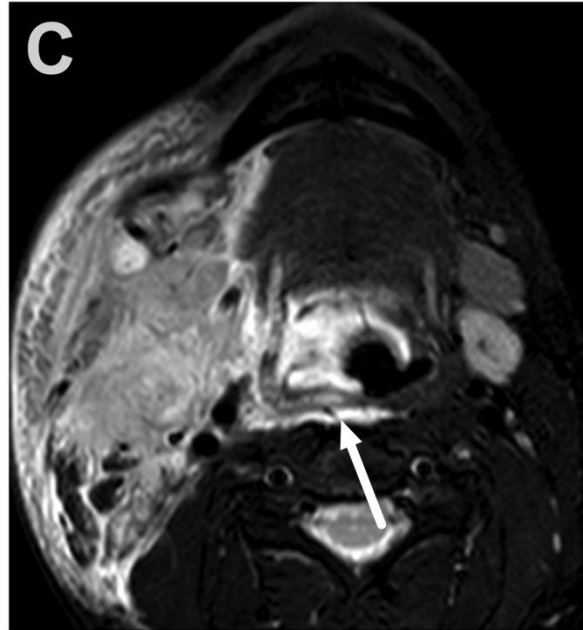
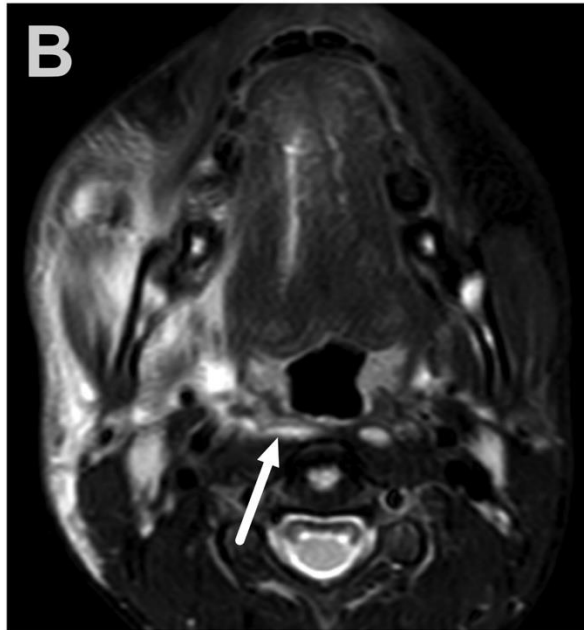
DL nnU-Net segmentation of neck abscesses on MRI



Prognostic imaging biomarkers

Reactive MRI edema patterns: RPE

Retropharyngeal edema (RPE) in 54 % of patients



N=371

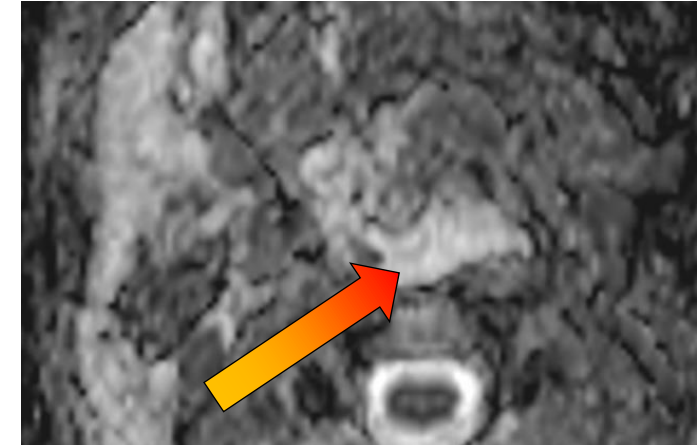
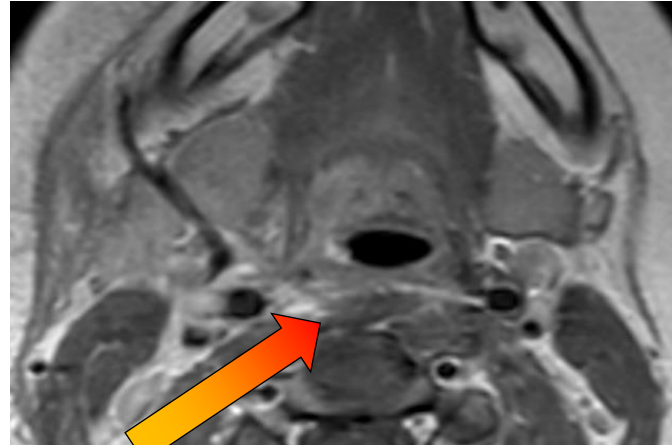
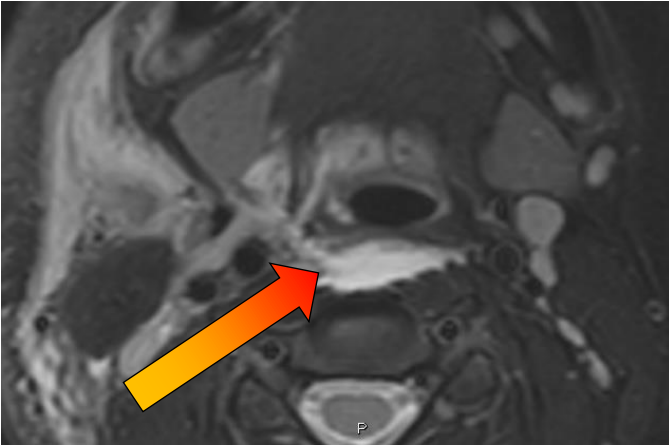
Teaching point: DWI separates between RPE and abscess

T2 ax

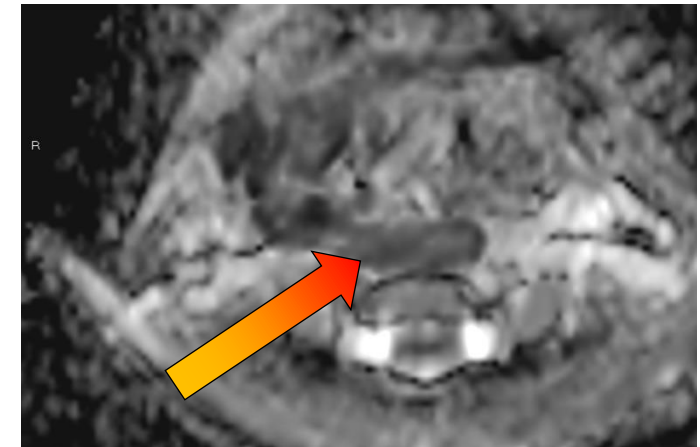
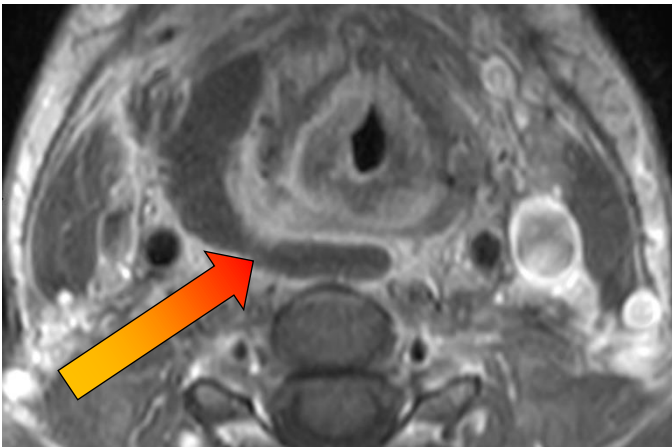
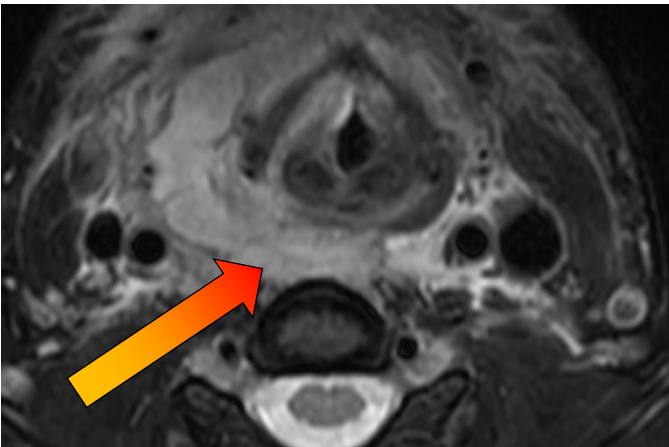
T1 post Gd

DWI (ADC)

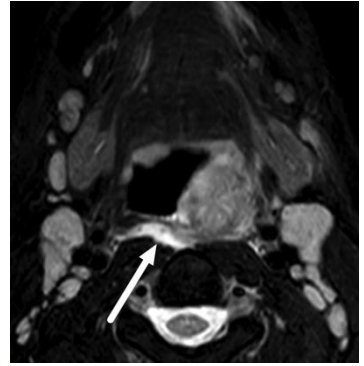
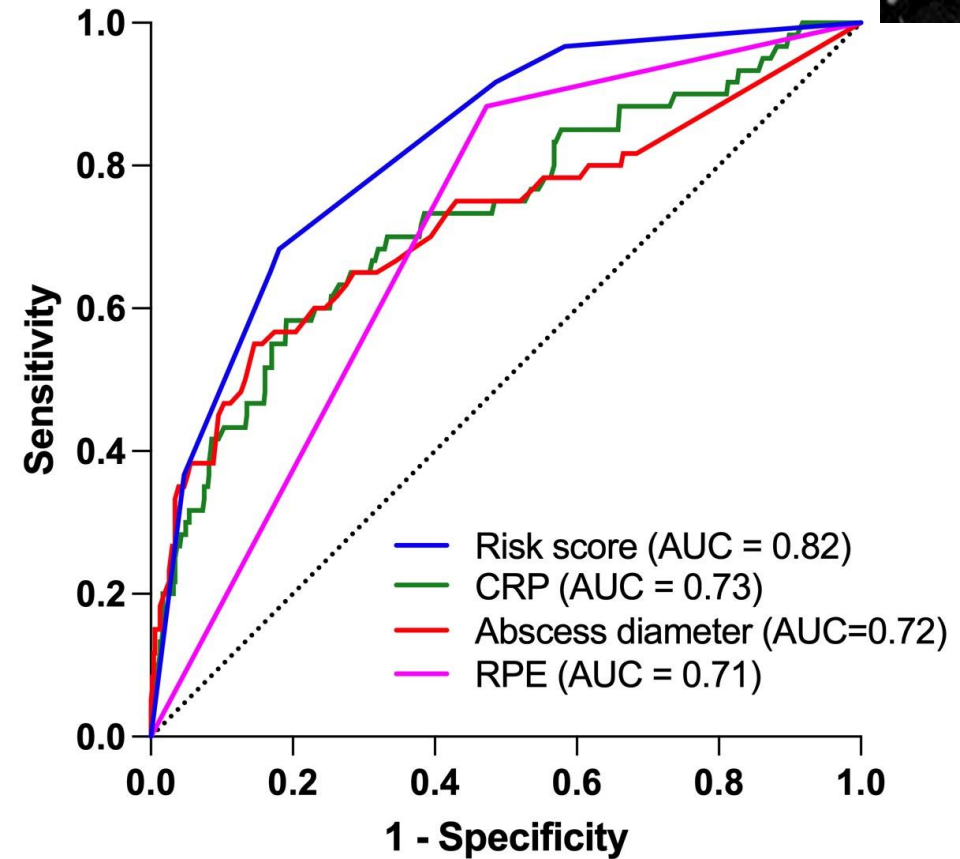
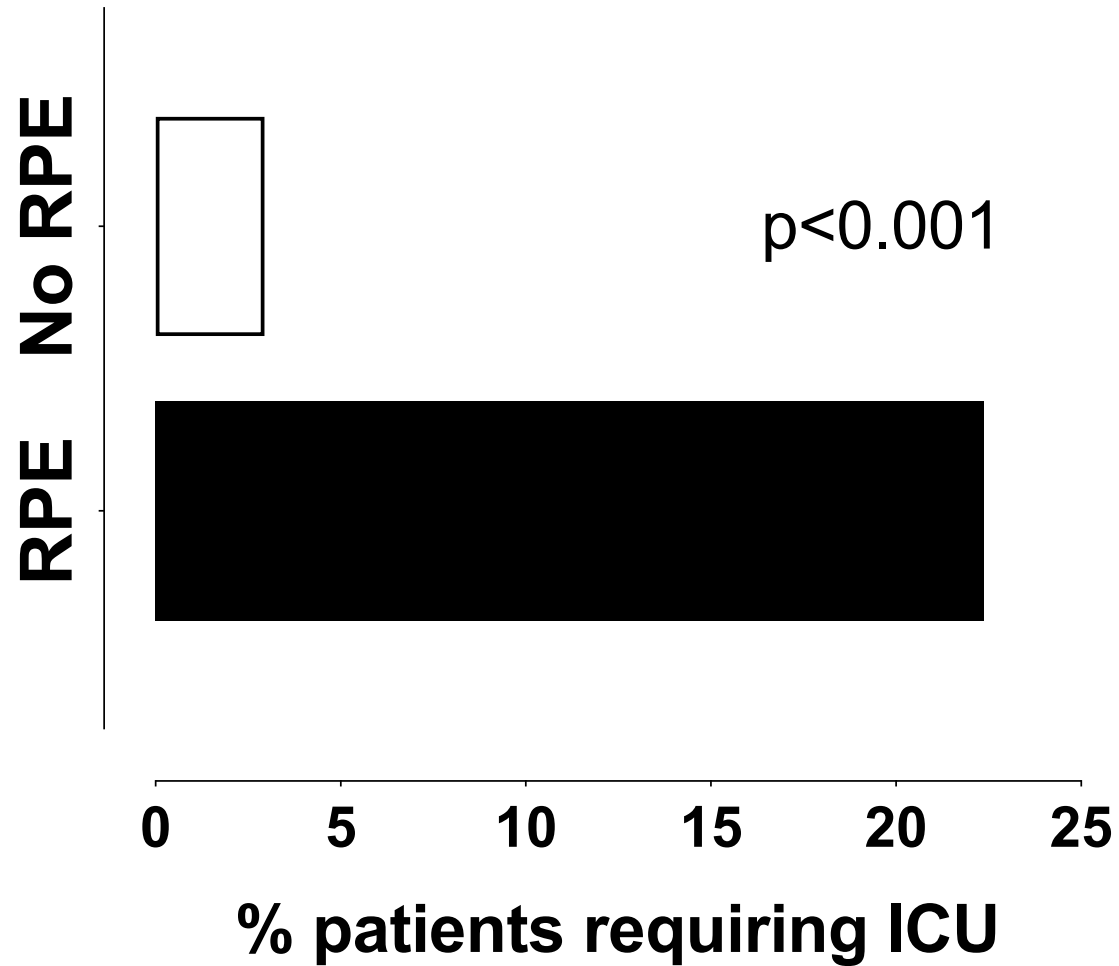
RPE



Abscess



RPE predict intensive care unit (ICU) admissions



ORIGINAL ARTICLE Open Access

Deep learning detects retropharyngeal edema on MRI in patients with acute neck infections

Oona Rainio^{1*}, Heidi Huhtanen², Jari-Pekka Vierula², Janne Nurminen², Jaakko Heikkinen², Mikko Nyman², Riku Klén¹ and Jussi Hirvonen^{1,2}

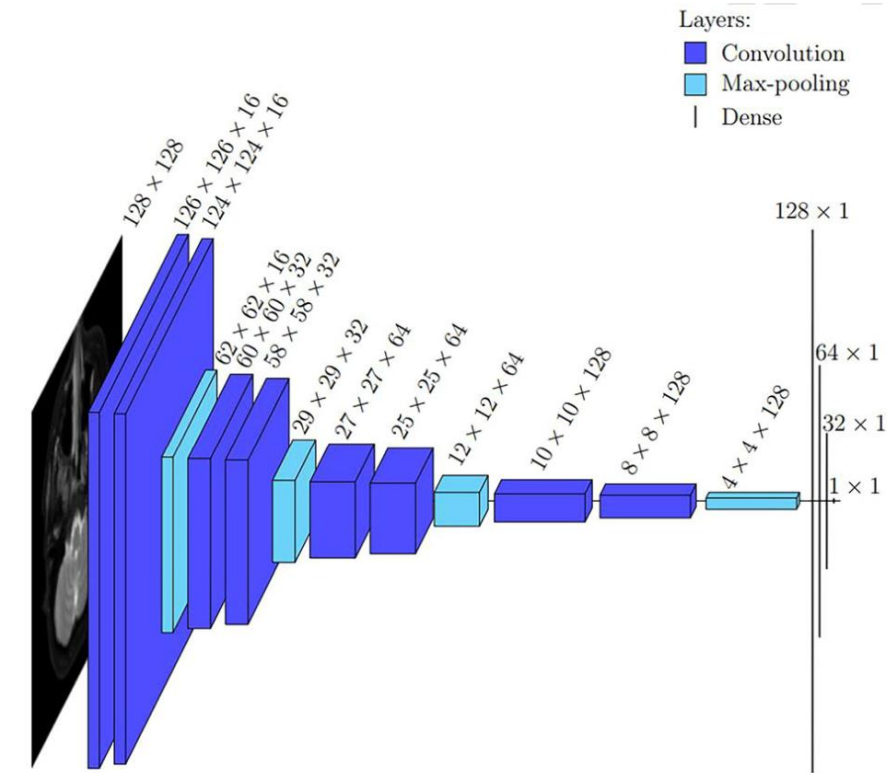
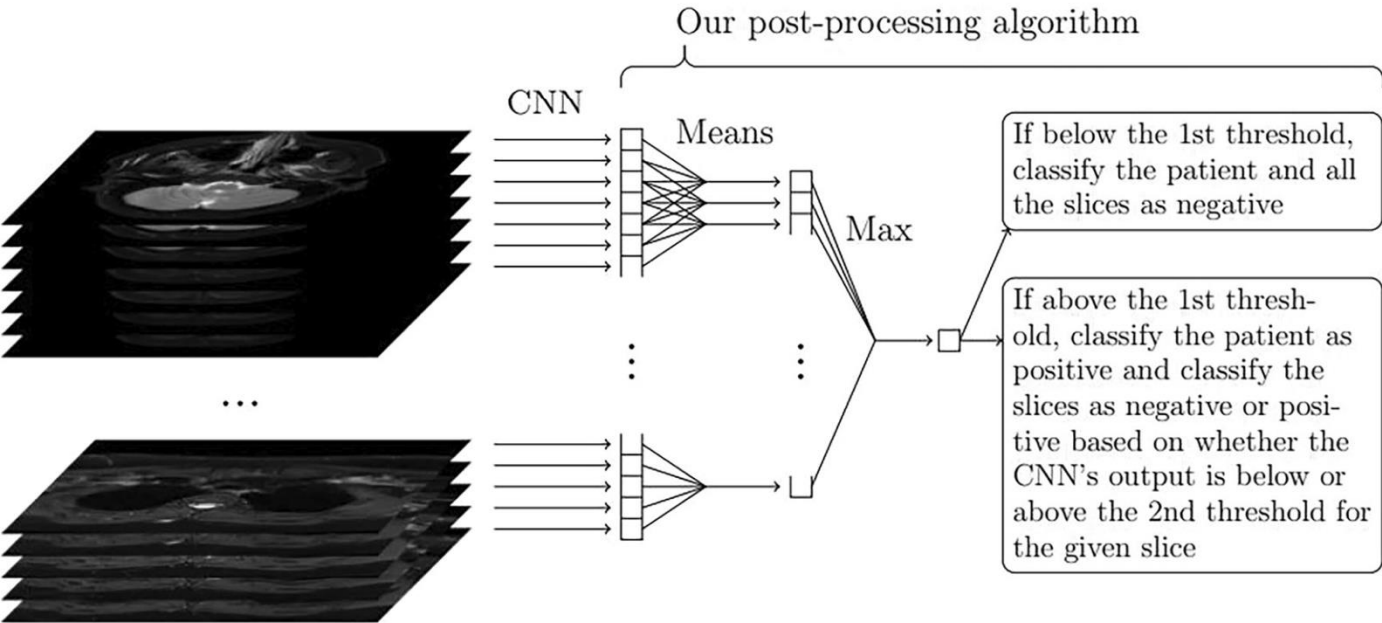


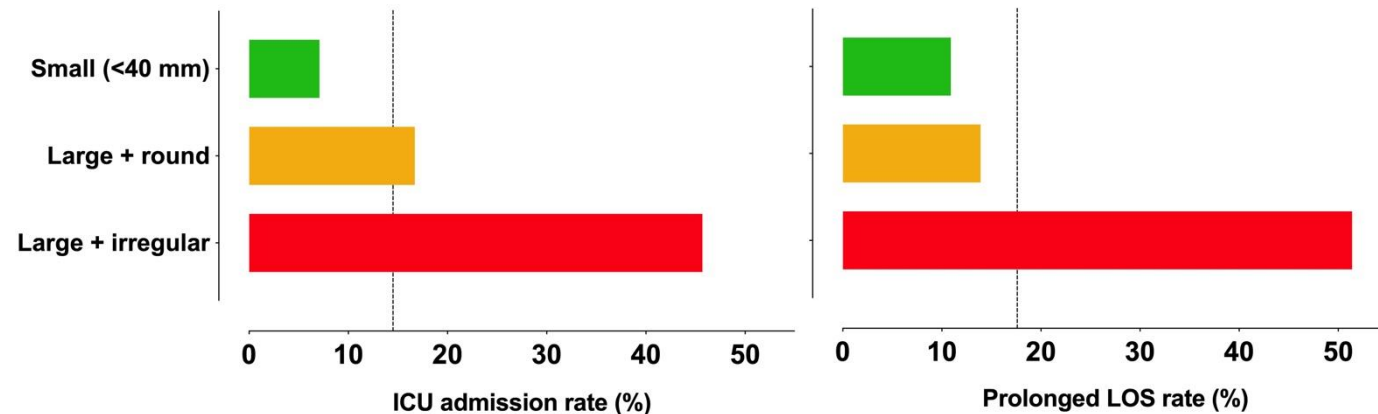
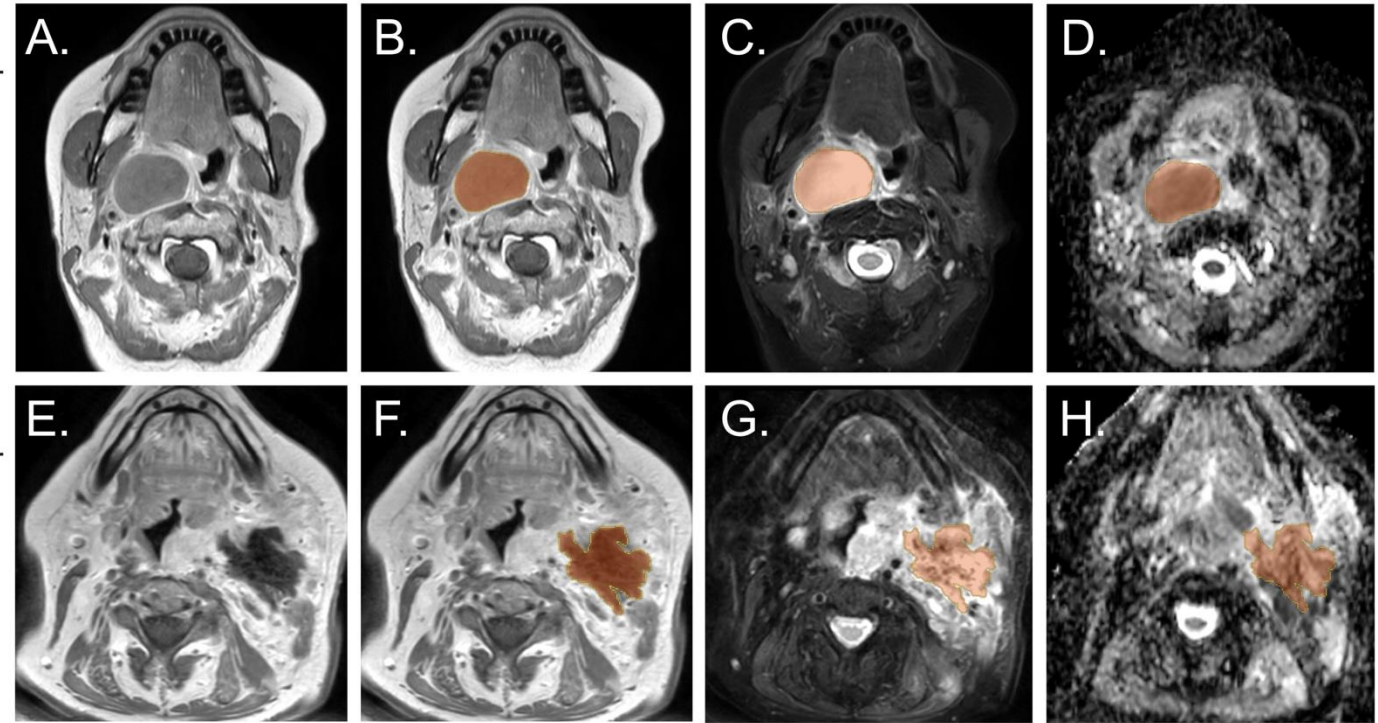
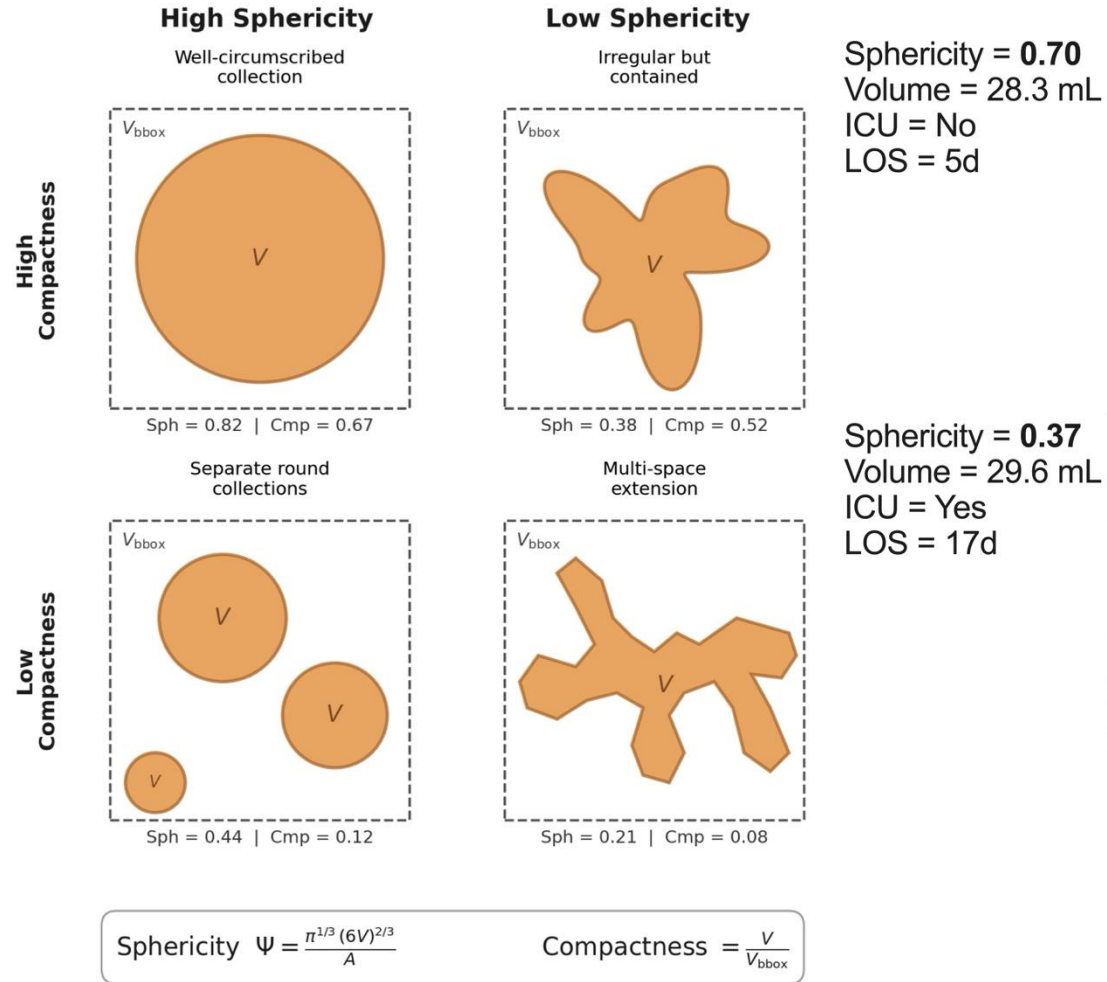
Table 1 Evaluation metrics for the proposed CNN

Metric	Patient level	Slice level
Accuracy (%)	87.4 ± 2.8/87.0	94.6 ± 0.4/94.6
Sensitivity (%)	86.5 ± 3.2/85.7	83.3 ± 3.6/82.7
Specificity (%)	88.2 ± 4.9/87.2	96.2 ± 0.7/96.2
AUROC (%)	94.8 ± 1.2/94.9	94.1 ± 1.3/94.0

Data are given as mean ± standard deviation/median of the four evaluation metrics computed both on patient level and on slice level with our proposed method (the convolutional neural network shown in Fig. 3 with vertical reflection augmentation followed by our new algorithm) during the 30 iterations of the repeated five-fold cross-validation



Abscess size matters, but so does irregularity



Artifacts & mimics

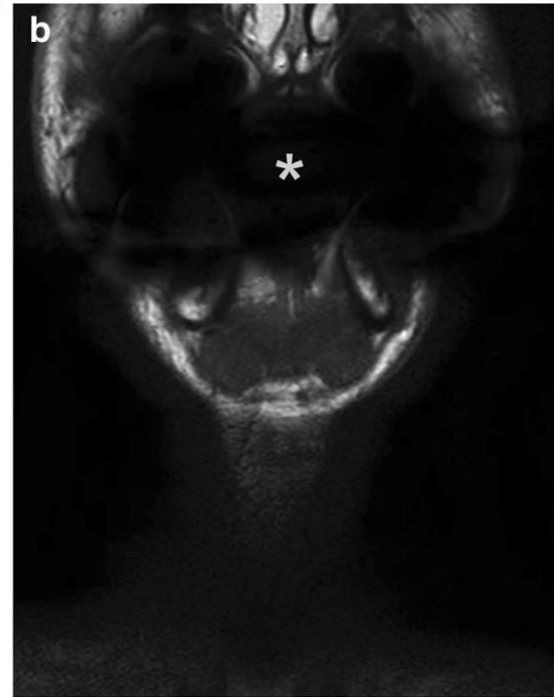
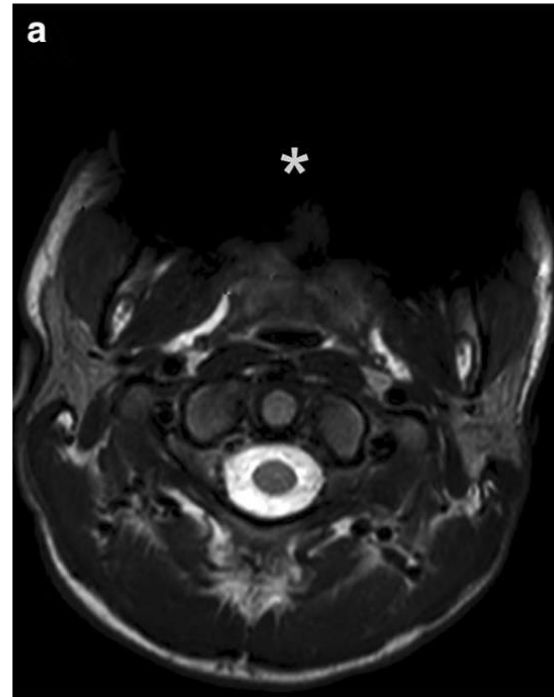
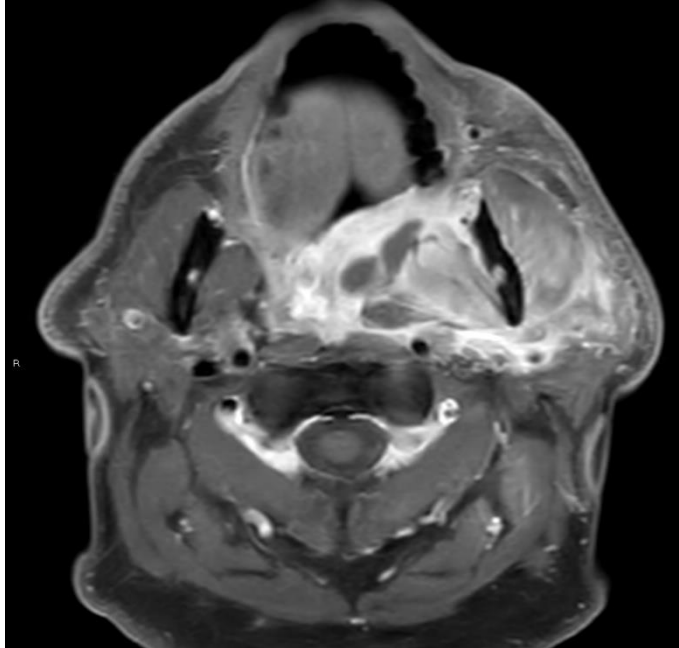
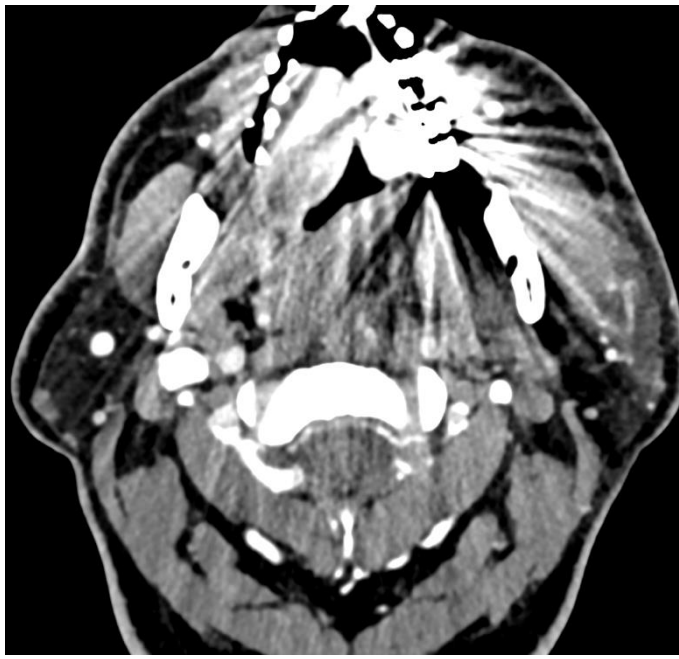
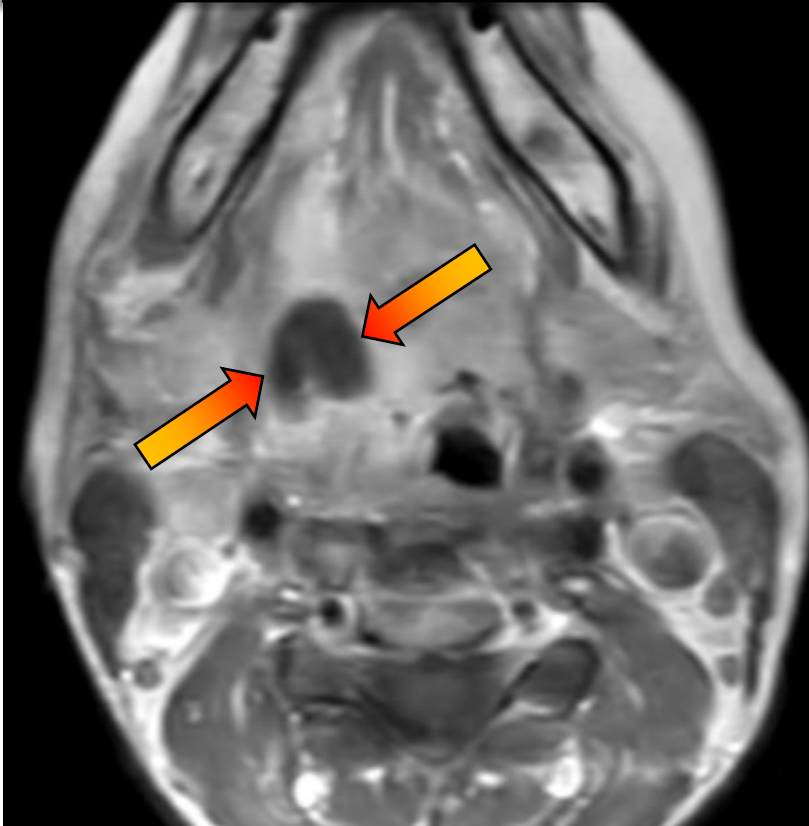


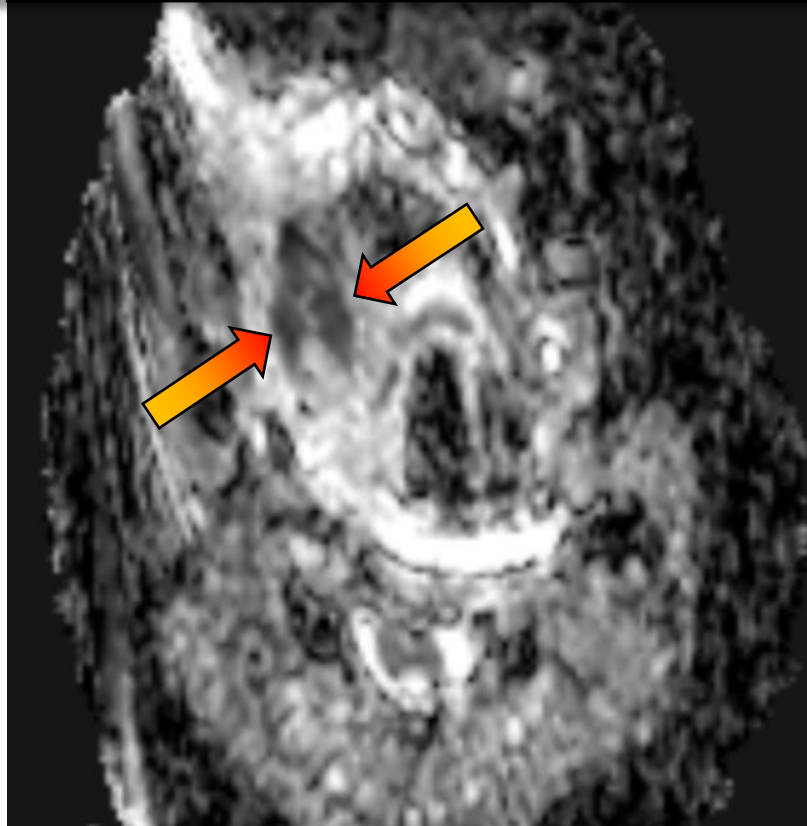
Fig. 26 Braces causing a significant signal loss in the area of the oral cavity (asterisk) in axial (a), coronal (b), and sagittal (c) T2-weighted images

EPI-based DWI may be distorted

T1 Gd MRI

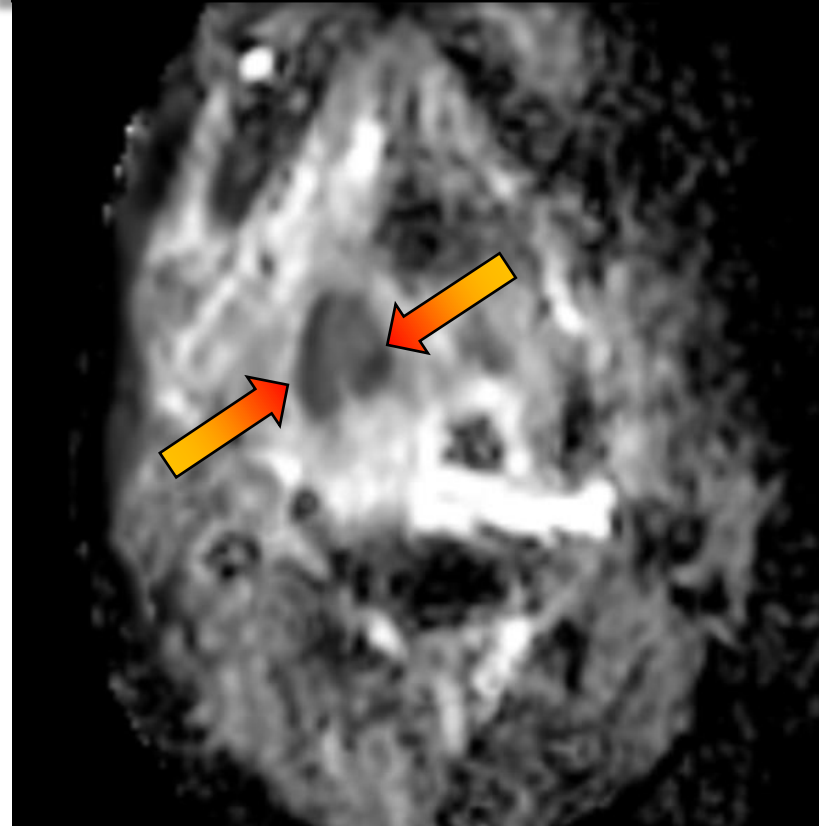


EPI DWI ADC



TA 1:00

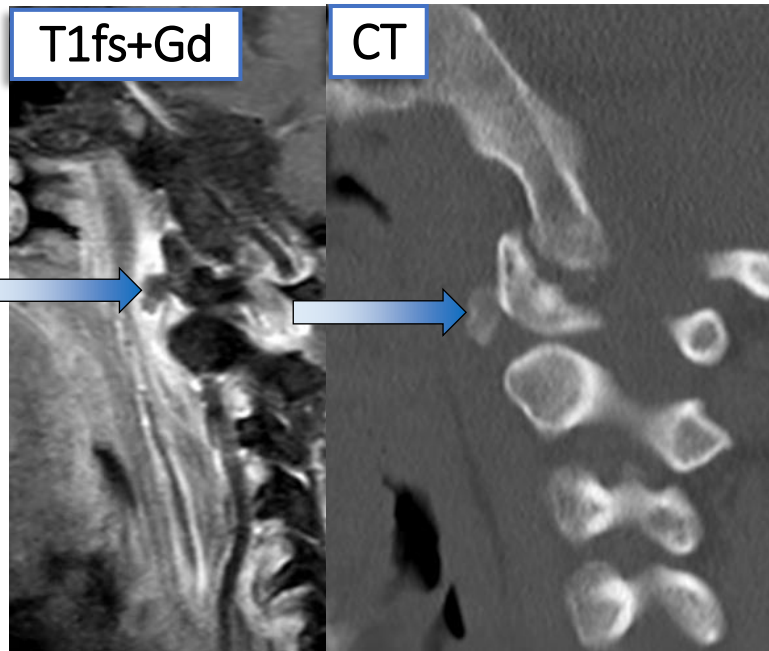
TSE DWI ADC



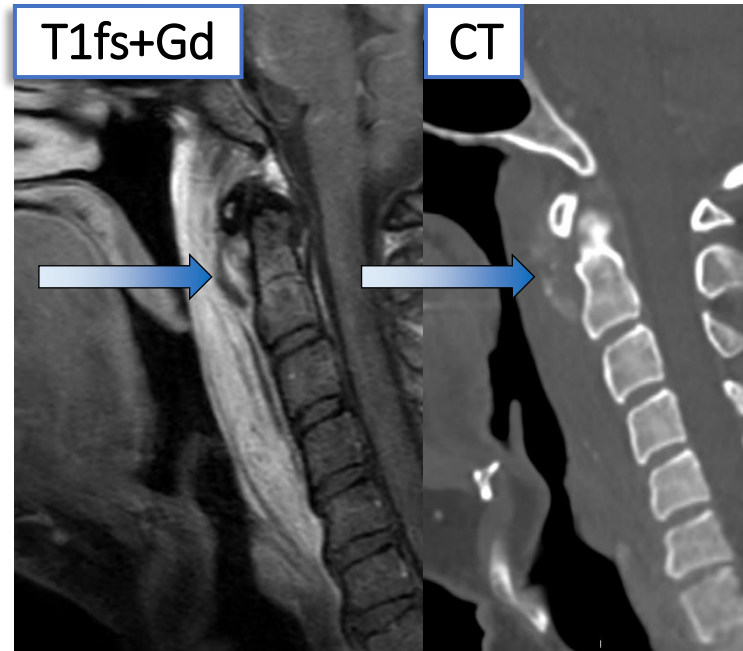
TA 5:00

Infection mimic: longus colli calcific tendinitis

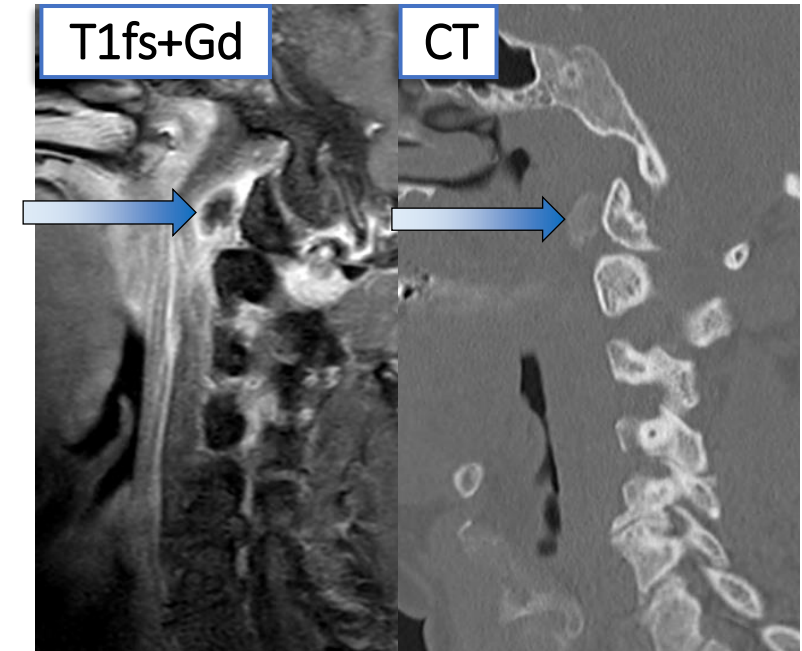
CRP 102, WBC 9.2



CRP 156, WBC 10.8

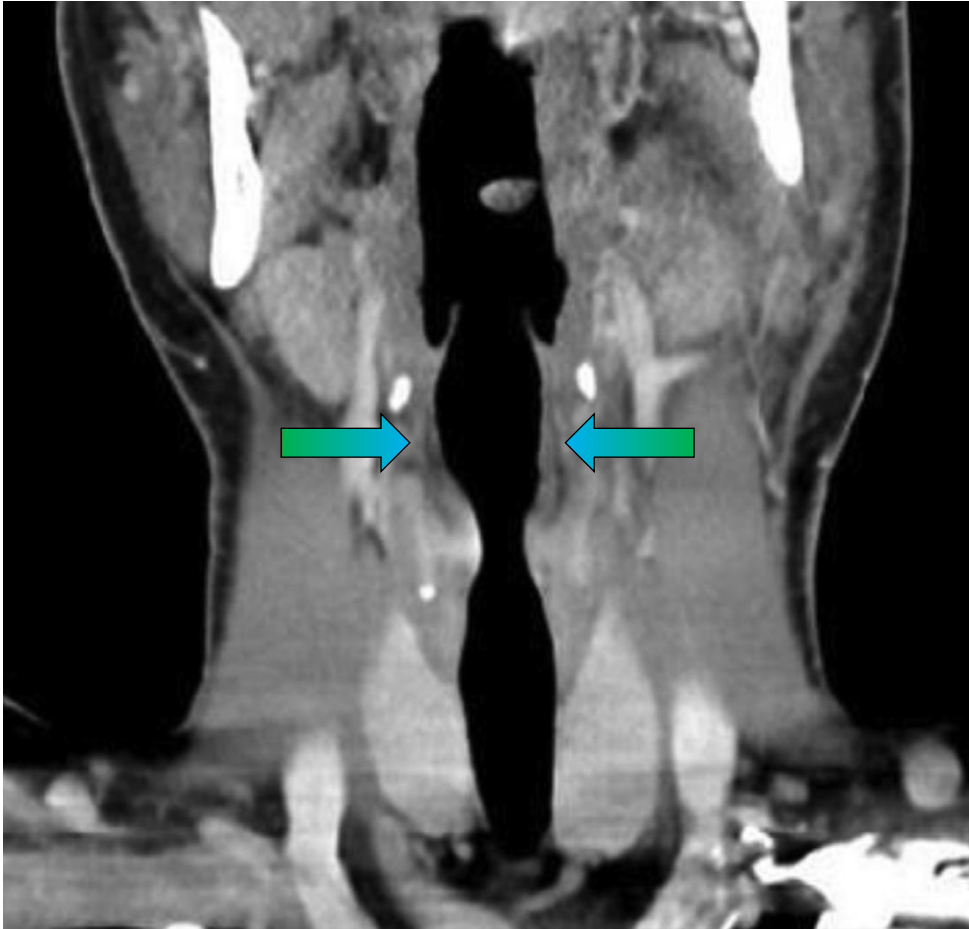


CRP 37, WBC 9.5

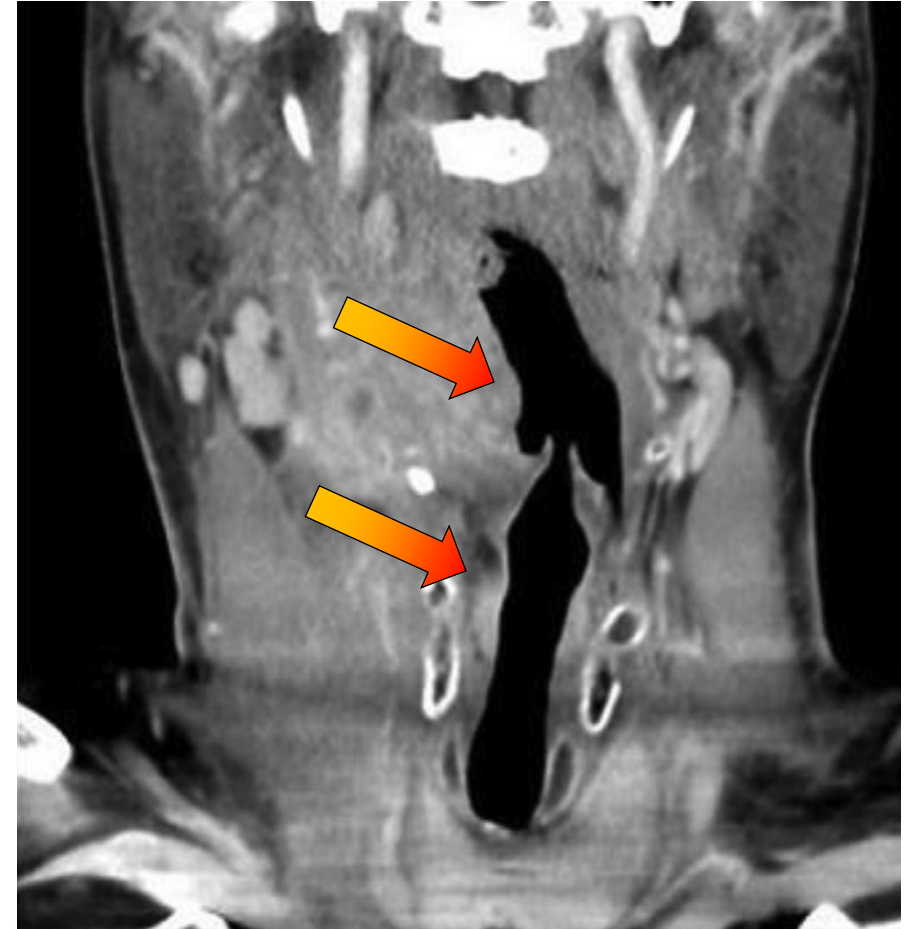


Complications

Imaging assessment of airway compromise

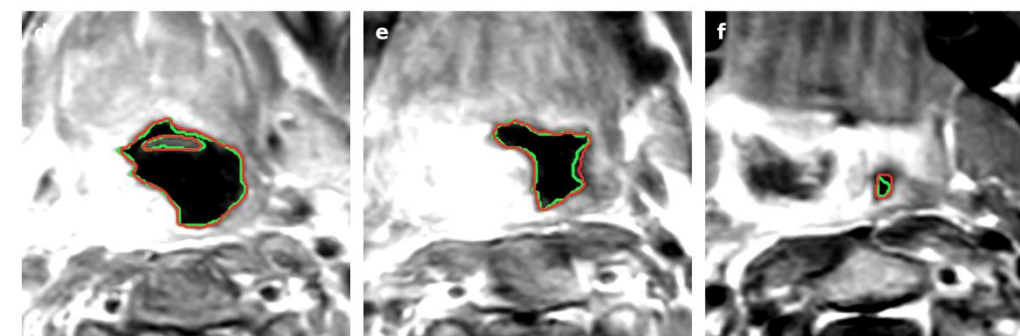
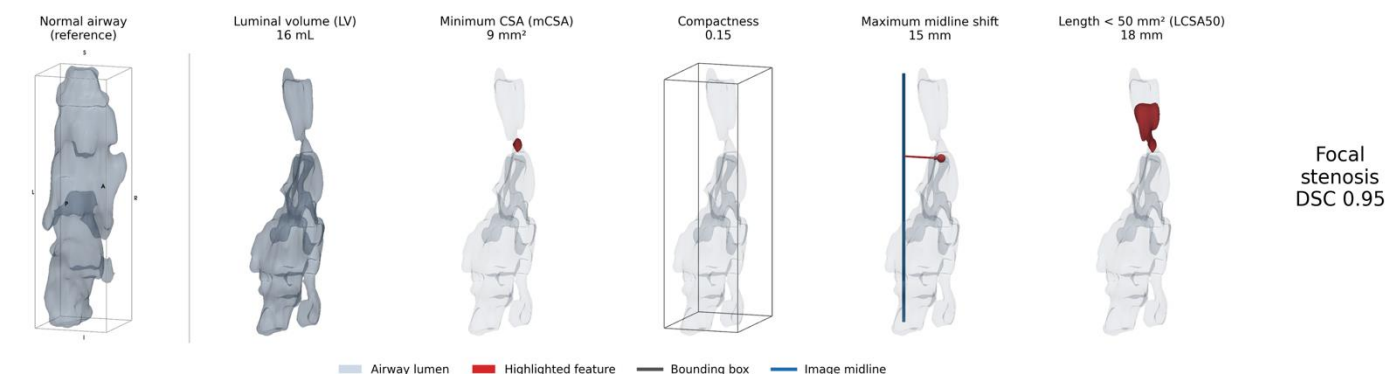


Uncompromised

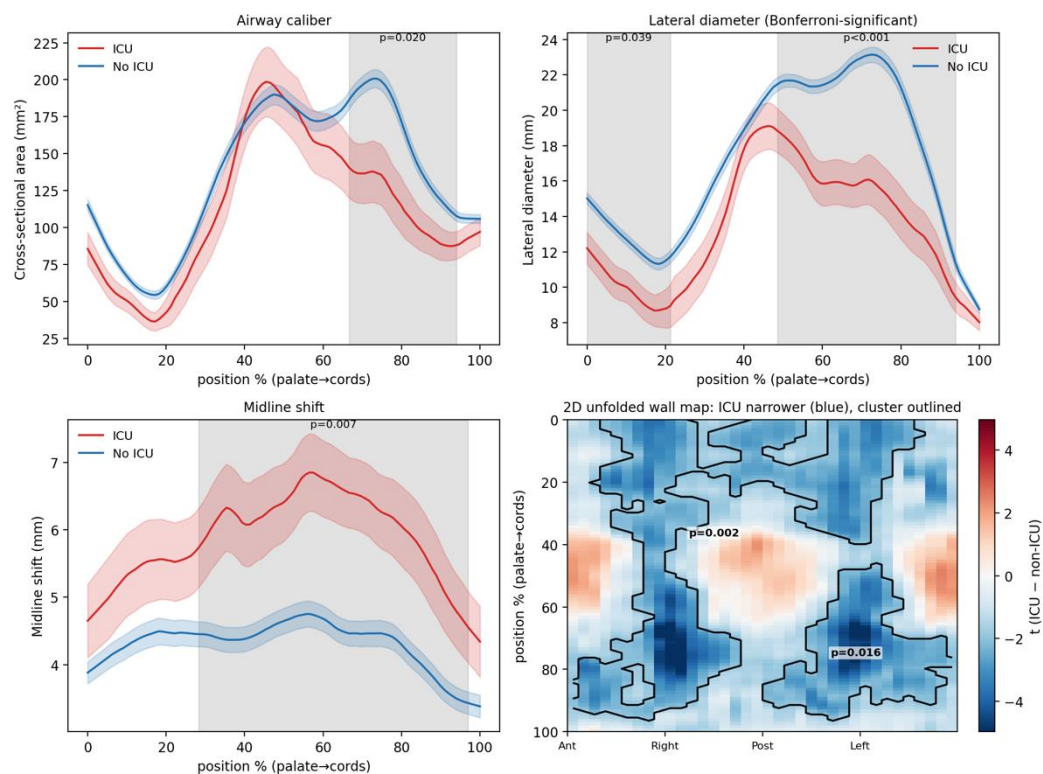


Compromised

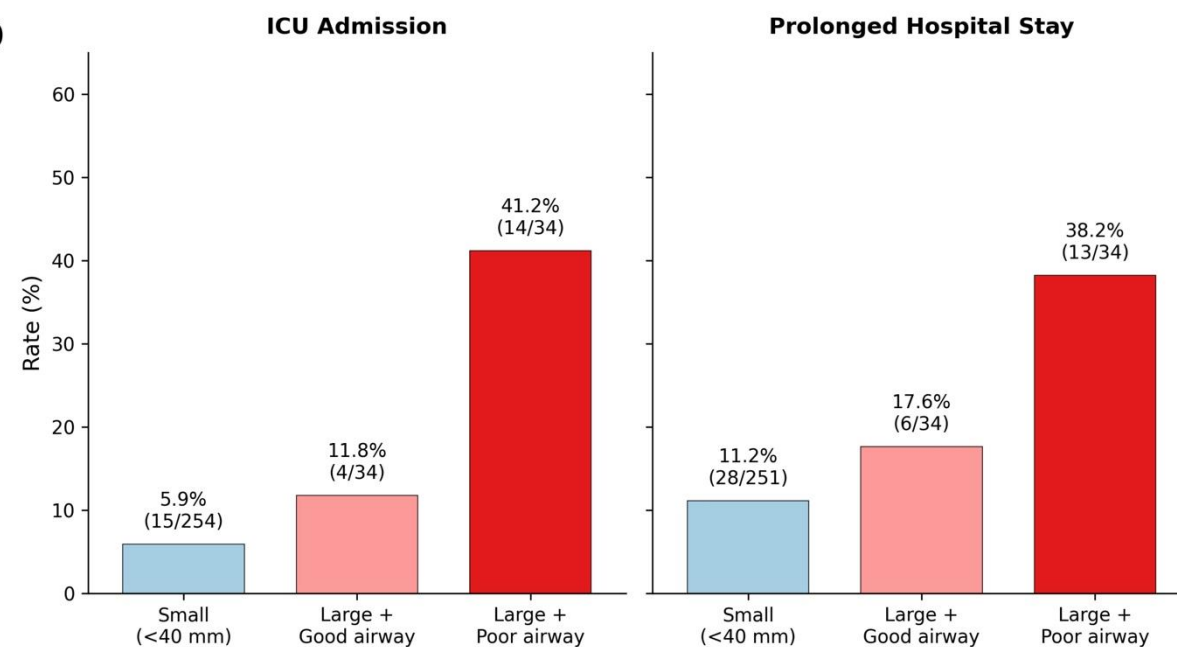
MRI-based airway morphometry



Manual reference (green line) nnU-Net prediction (red line)

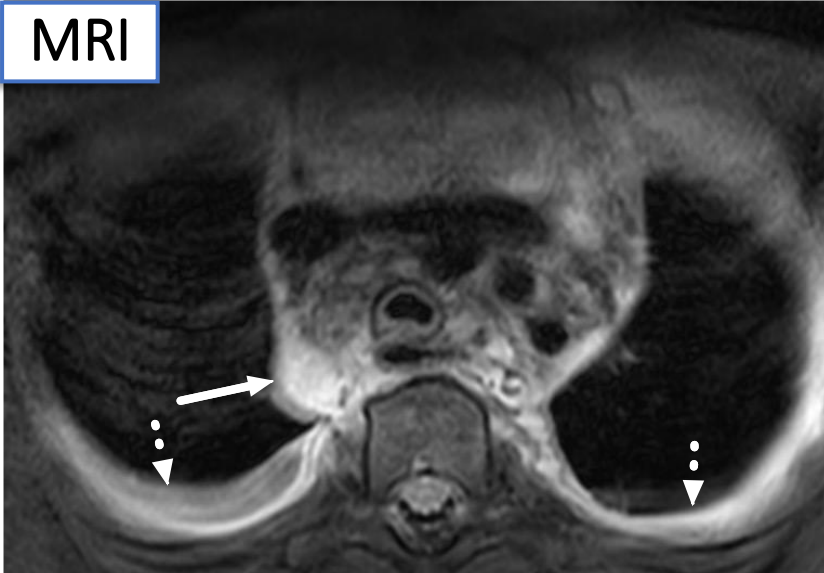


b



Descending mediastinitis: posterior route via RPS/DS

MRI



MRI



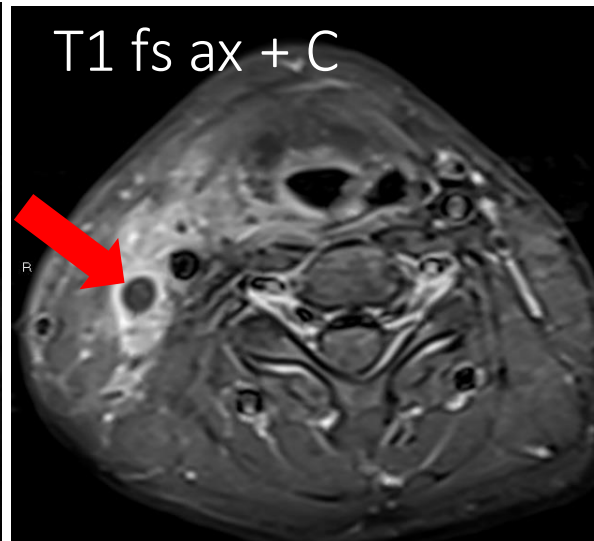
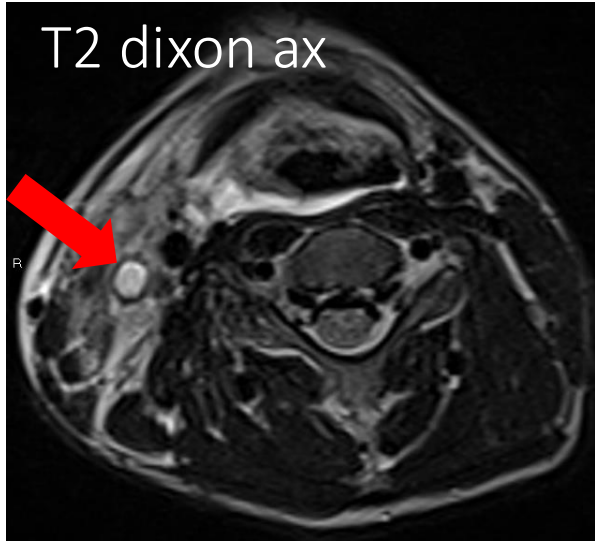
MRI



CT



Lemierre's syndrome: venous thrombosis



Dx: Lemierre syndrome (*F. necrophorum*)

Take home: Five critical findings

1 Deep neck abscess

CT/MRI; size & location matter; irregular shape predicts worse outcome

2 Retropharyngeal edema (RPE)

Mimics abscess on CT — DWI separates reactive edema from pus

3 Airway compromise

Narrowed or displaced lumen impact intubation planning

4 Descending mediastinitis

Always look below the clavicles on a neck CT/MRI

5 Vascular thrombosis

Check the internal jugular vein — think Lemierre's



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